EPA

A Comparison of Alternative Approaches for Estimating Recreation and Related Benefits of Water Quality Improvement

"The information in this document has been funded wholly or in part by the United States Environmental Protection Agency under Contract No. 68-01-5838. It has been subject to the Agency's peer and administrative review, and it has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use."

March 1983

A Comparison of Alternative Approaches for Estimating Recreation and Related Benefits of Water Quality Improvements

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EPA Contract No. 68-01-5838

PREFACE

This research project was initiated and supported under work agreement 68-01-5838 by the Benefits Staff in the Office of Policy Analysis at the U.S. Environmental Protection Agency (EPA).

Throughout this research effort, the authors of this report were fortunate enough to take advantage of research activities already in progress. One author had partially completed an analysis of the problems of defining and measuring option value, for example, and another had partially completed research to design a generalized travel cost site demand model. In addition, the authors also benefited from free access to any array of related working papers–many of which have subsequently been published–that improved the final research design beyond that possible otherwise. Finally, access to an independently developed estimator for ranked data improved the authors' ability to make certain types of comparisons for the contingent ranking component of the survey. Although none of these complementary activities was contemplated when the project was initially proposed, each has played a substantial role in the final results, We would not expect these same circumstances to be easily replicated in future projects of comparable scale and duration.

This final report has been substantially improved through the constructive comments of many reviewers. In particular we would like to thank Ann Fisher, the EPA project officer, for her careful commentary and continuous support. In addition, as part of the EPA's review, six other individuals furnished detailed comments:

Richard Bishop, University of Wisconsin
Rick Freeman, Bowdoin College
Bill Lott, University of Connecticut
Robert Mitchell and Richard Carson, Resources for the Future (RFF)
Bill Schulze, University of Wyoming.

In addition, useful comments were also received from the following individuals:

Tayler Bingham, Research Triangle Institute (RTI)
Peter Caulkins, U.S. EPA
Warren Fisher, U.S. Fish and Wildlife Service
David Gallagher, University of New South Wales
Debbie Gibbs, Bureau of Reclamation
Jerry Hausman, Massachusetts Institute of Technology
Reed Johnson, U.S. Naval Academy and U.S. EPA
John Loomis, U.S. Forest Service
Glenn Morris, RTI
Doug Rae, Charles River Associates
Liz Wilman, RFF.

The authors also have benefited from the comments of participants at presentations given at RFF; Vanderbilt University; the University of Missouri-Rolla; Dillon, Colorado (Visual Values Workshop); Research Triangle Park (Triangle Econometrics Seminar); and Washington, D.C. (EPA). We are most grateful for all these efforts. Finally, we are most appreciative of the efforts of our editor, Hall Ashmore, and of Jan Shirley, Supervisor of RTI's Word Processing Center.

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CHAPTER 1

INTRODUCTION, OBJECTIVES, AND SUMMARY

1.1 INTRODUCTION

This Research Triangle Institute (RTI) report to the U.S. Environmental protection Agency (EPA) compares alternative approaches for estimating the recreation and related benefits of water quality improvements. The results provide information on the performance of various ways to estimate the benefits of environmental quality improvements, so EPA can use such methods in preparing the regulatory impact analyses required by Executive Order 12291 and in evaluating other regulatory proposals. This report is also relevant to the proposed revision of the Federal water quality standards regulations, which recommends that States consider incremental benefits and costs in setting their water quality standards. Site-specific water quality standards are likely to play an important role in future water policy issues because they bring together the crucial elements of appropriate stream uses and advanced treatment requirements for municipalities and industries. Benefit-cost assessments can yield valuable information for these decisions.

Evaluations of benefits and costs depend on a determination of the links between regulatory policy, technical effects, and behavioral responses. Figure 1-1 illustrates one set of linkages -- in this case for the proposed water quality standards regulations. This report addresses the last component of Figure 1-1, which involves estimating monetized benefits for regulatory policy. One of the difficulties in such a task arises from the absence of organized markets for many of the services derived from water resources.

The benefits of water resource regulations are usually measured with one of three types of approaches: (1) market-based approaches, which use indirect l in kages between the environmental goods and some commodities exchanged in markets; (2) contingent valuation approaches, which establish an institutional framework for a hypothetical market; and (3) public referenda. This report considers the first two approaches; the last is omitted since it is beyond EPA's mandate.

Some opponents argue that benefit-cost analysis is invalid because it cannot measure all of the benefits of environmental regulations. Nevertheless, this report describes the measurement of several benefits from water quality improvements, including some regarded as unmeasurable in earlier environmental benefits research efforts. Specifically, as highlighted in Figure 1-2, this study considers both the recreation benefits that accrue to users of a recreation site and the intrinsic benefits* that accrue to both users and nonusers.

*This classification modifies the one in Mitchell and Carson [1981].

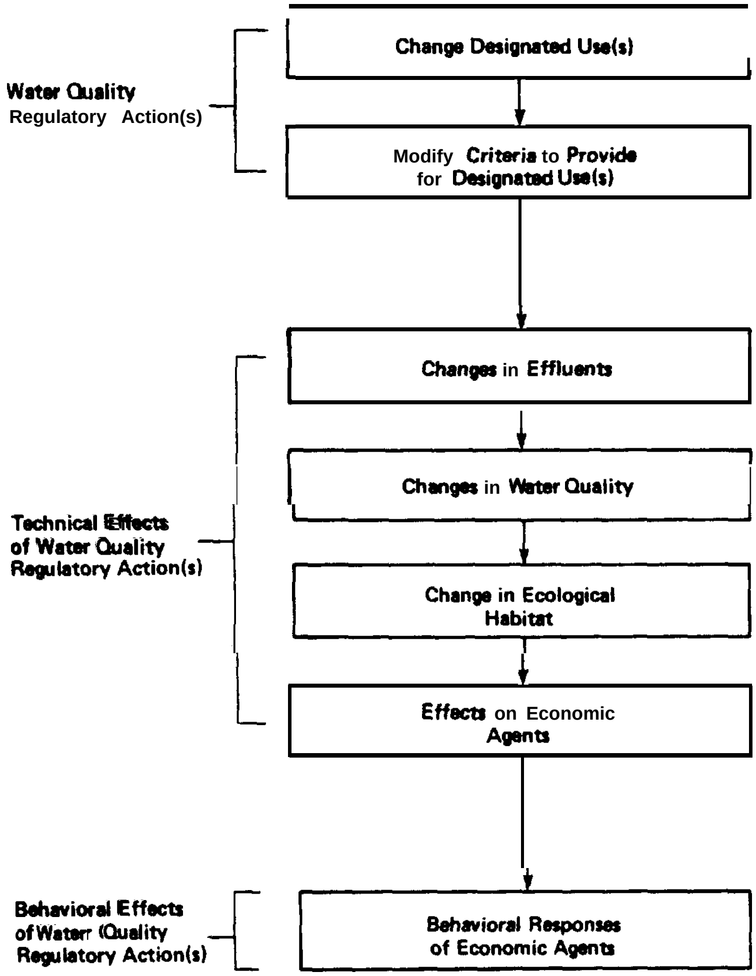

Figure 1-1. Effects and responses to water quality regulatory actions.

User benefits arise from recreation uses of the river and are measured by users' willingness to pay for the water quality levels necessary to permit these recreation uses. That is, the valuation depends on the use of the river. In this case, clean water in a river is worth something because recreationists are going to fish, boat, swim in, or picnic along the river.

Intrinsic benefits consist of two value types: option value and existence value. Relevant to both current users and potential future users, option value is the amount an individual would be willing to pay for improved water quality (over his expected user values) to have the right to use the river in the future when there is uncertainty either in the river's availability at a particular quality level or in his use of it (with the river meeting specified water quality conditions). For example, if an individual might use the river, but is not sure he will, he may pay some amount each year for the right (or option) to use it (with the river meeting specified water quality conditions). Under some conditions, this payment, the option price, will exceed his expected consumer surplus--the value he would derive from anticipated use. This excess--the amount that the option price exceeds the expected consumer surplus--is defined as the option value.

Potential Water Quality Benefits	Current User Benefits	Direct use	In Stream	Recreational*– fishing, swimming, boating, rafting, etc.
				Commercial – fishing, navigation
			Withdrawal	Municipal – drinking water, waste disposal
				Agricultural – irrigation
				Industrial/Commercial – cooling, process treatment, waste disposal, steam generation
		Indirect use	Near Stream	Recreational*– hiking, picnicking, birdwatching, photography, etc.
				Relaxation*– viewing
				Aesthetic”– enhancement of adjoining site amenities
	Intrinsic Benefits	Potential use	Option*	Near-term potential use
				Long-term potential use
		No Use	Existence*	Stewardship – maintaining a good environment for everyone to enjoy (including future family use–bequest)
				Vicarious consumption – enjoyment from the knowledge that others are using the resource.

* Considerad in this project.

Figure 1-2. A spectrum of water quality benefits.

Existence value, on the other hand, is an individual’s willingness to pay for the knowledge that a resource exists. That is, an individual--either a user or a nonuser--might be willing to pay something to maintain a high level of water quality at a recreation site in a particular area, even though he will not use it, so that his children may have future use of the site or simply to know that the ecosystem at the site will be maintained.

This study’s comparison of alternative benefits measurement approaches estimates user values by the travel cost approach (indirect method), by four different ways of eliciting option price in a contingent valuation experimental design (direct method), and by a contingent ranking of water quality outcomes and option price amounts. The central comparison evaluates whether there are differences between approaches because “true” values for each of these types of benefits are unknowns. In addition, since the other methods are not suitable for measuring them, option and existence values are compared only in terms of alternative ways for posing the hypothetical questions.

A distinguishing feature of this project is its use of a case study of the Pennsylvania portion of the Monongahela River as the point of reference for both the comparison of approaches and the estimation of option and existence values. The Monongahela is representative of a number of rivers in the country, has multiple uses, and has recently been the focus of effluent guidelines for the iron and steel industry. The survey design for the Monongahela, calling for a household survey, is a middle ground between the macro approach for estimating benefits of water po{lution controls (see Mitchell and Carson [1981]) and the user orientation of many micro contingent valuation efforts (see Schulze, d'Arge, and Brookshire [1981]). The design uses a representative sample of households for the region and, similar to Mitchell-Carson, includes both user and intrinsic benefits. It also is a specific application, considering individuals' willingness to pay for a specific river basin's water quality.

1.2 OBJECTIVES

The potential implications of this study for water policy dictated clearly defined objectives and a project design to achieve them. The overall objective of this project was to conduct a study comparing alternative approaches for estimating the recreation and related benefits of different water quality levels. In particular, the study sought to measure user, option, and existence values for the Pennsylvania segment of the Monongahela River and to estimate the recreation and related benefits that would be derived from providing different use classifications (fishable, swimmable, beatable) for this river segment.

In addition to meeting its own specific objectives, an environmental benefits research project ideally would fit the needs of those involved in the evaluation of public policy questions and the needs of the research community in general. Since the most important direct use of natural environments is for water-based recreation (see Freeman [1979a]), this project's general research area considers one of the primary components of environmental benefits research. In addition to its water quality orientation, the project is also relevant to two areas Freeman identified for future research:

> I think that a major research effort should be made to select an appropriate area and water bodies for a study, to develop a properly specified model, and to gather the necessary data. Until such an effort is made, the practicality of the Clawson-Knetsch [1966] [travel cost] technique for estimating recreation benefits will remain an open question. [p. 256]

> There should be carefully conducted experiments with the survey techniques for estimating willingness to pay for reduction in pol lu - tion. These experiments should be coordinated with studies based on other analytical techniques in an effort to provide a cross-check or validation of benefit estimates obtained by different approaches. [p. 265]

1.3 SUMMARY OF RESULTS

This section summarizes the major findings of the research. The findings are presented for individual approaches and for the comparison between appreaches.

1.3.1 Overview

The results of this project strongly support the feasibility of measuring the recreation and related benefits of water quality improvements. Moreover, the benefits measurement approaches --several contingent valuation formats and the travel cost method -- show consistent results for comparable changes in water quality. Indeed, the range of variation is generally less than that expected in models used to translate the effects of effluents in a water body into the corresponding water quality parameters. In addition, the results also clearly show that the intrinsic benefits of water quality improvements--especially option values --can be measured and that they are a sizable portion -- greater than half--of the total recreation and related benefits total.

1.3.2 Contingent Valuation Appreach

Based on the results of the Monongahela River case study, the general prognosis is good for the continued use of the contingent valuation approach to estimate the benefits of water quality improvements. Statistical analysis using regression methods to evaluate the determinants of the variation in the option price bids gave little indication that individual interviewers influenced the results. The consistently plausible signs and magnitudes of key economic variables suggest that the respondents perceived the survey structure as realistic and did not experience problems with the hypothetical nature of some of the questions. These findings were realized despite the fact that the sample included households whose socioeconomic profile was comparable to demographic groups that were found to be more difficult respondents in past contingent valuation surveys. On average, the respondents were older, less educated, and poorer than those in the most successful contingent valuation studies.

The contingent valuation estimates of the option price for water quality improvements, which include user and option values , are consistently plausible across the various analytical approaches, with estimates for the combined water quality levels ranging from roughly $50 to $120 per year per household sampled in the Monongahela River basin. Nonetheless, the empirical results do indicate that the methods used to elicit the willingness-to-pay amount have a statistically significant effect on the estimates of willingness to pay. For example, both the direct question with a payment card and the bidding game with a $125 starting point produced higher willingness-to-pay estimates than either the direct question without an aid or the bidding game with a $25 starting point. Thus, there is some evidence of starting point bias in the bidding game, but the statistical analyses are not conclusive. The results comparing the two bidding game methods as a set (i.e. , those with $25 and $125 starting points) with the non bidding games (direct question and payment card combined) indicated no differences between these two sets of approaches.

The findings provide clear support for a positive, statistically significant, and sizable option value for water quality improvements along the Monongahela River. The estimated option values for loss of the use of the area in its current condition (i .e. , boatable) range from approximately $15 to $60 per year per household, and the option values for improving water quality to a swimmable level range from approximately $20 to $45 per year per household. Thus, option value is a substantial fraction of the user's option price, and the value of this change in water quality generally exceeds user values.

The survey also provided estimates of existence values. Unfortunately, respondents did not necessarily understand the distinction sought. Many bid the same amounts as they had earlier on the option price for a comparable change in water quality. It is not clear whether these responses were deliberate or a reflection of misunderstanding of the questions. Thus, while the findings suggest that these values are positive and statistically significant, prudence requires they be interpreted cautiously.

Of course, it should also be acknowledged that the available estimates of intrinsic values are quite limited. Most can be criticized for problems in the research design, including possible flaws in the survey. The design of the Monongahela River study relies on the use of a schematic classification of the sources of an individual's valuation of the river (i.e. , a card showing different types of values) in eliciting a division of user and other benefits. Because this is the first application of this device, it was not possible to evaluate its effectiveness.

In addition to the more widely used bidding game and direct question formats for contingent valuation experiments, the Monongahela River basin survey also applied the contingent ranking format. This format requires only that individuals rank combinations of water quality levels and option prices and uses a statistical procedure (ranked order logit)* to estimate willingness to pay. While other contingent valuation formats require that individuals directly provide willingness to pay, contingent ranking asks them to rank hypothetical outcomes. In effect, it asks a simpler task of the respondent-- only to rank outcomes -- but requires more sophisticated and less direct techniques to estimate the value of the outcomes.

Since use of the contingent ranking format to estimate the benefits of environmental quality improvements is quite new, the behavioral model underlying its estimation procedures is also early in its development. Although this project provides a description of these underpinnings, its evaluation of the theoretical properties and practical issues is incomplete. Overall, the findings of this study suggest that, even though the behavioral models used to derive benefits estimates with the contingent ranking format were somewhat arbitrary, the results from the ranking format closely parallel other contingent valuation estimates.

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*In more technical terms, the procedure uses a specification for the indirect utility function together with a maximum likelihood estimator.

The mean estimates derived from the contingent ranking format--roughly $60 annuallY Per household for improving water quality in the Monongahela to fishable and approxiamtely $50 more annually for improving it to swimmable--appear larger than those derived with other contingent valuation formats. However, these differences are not statistically significant. In addition, the benefit estimates from all continent valuation formats are comparable across individuals, with the primary differences between contingent ranking and other methods stemming from the questioning format used in the other methods.

1.3.3 Travel Cost Approach

This study also developed and used a generalized travel cost model to predict the recreation benefits of water quality improvements at recreation sites.

The travel cost model assumes that site features or attributes affect both an individual's ability to participate in recreation activities at any particular site and the quality of his recreation experiences at the site. In considering the demand for a recreation site as a derived demand, the common sense rationale of the model suggests that a recreation site's features or attributes will influence the demand for its services. Since the level of water quality is a site attribute, a basis is established for relating water changes to shifts in demand for a recreation site's services.

The generalized model was estimated from data on 43 water-based recreation sites in the Federal Estate Survey component of the 1977 National Outdoor Recreation Survey. This survey provided information on recreation use patterns at each site during a single season. Based on sample sizes for each site that ranged from approximately 30 to several hundred respondents, the survey described individuals' recreation behavior, socioeconomic characteristics, travel time necessary to reach the site, residential location, and a variety of other factors.

Several advantages of this travel cost model include:

- Deriving individual estimates for the time associated with traveling to the site as well as the roundtrip distance for each trip.
- Using the opportunity cost of time to evaluate travel time and estimating opportunity cost for each individual based on his characteristics, including age, education, race, sex, and occupation.
- Considering for each site the potential effects of individuals' differences in onsite time per visit.

The generalized model was used to estimate the benefits for users of the Monongahela River, as identified in the survey of the basin. The travel cost model predicted a value of $83 per year per user household if a decrease in water quality is avoided and a value of $15 per year for each user household if water quality is improved to a swimmable level.

Several features of the generalized travel cost model are of particular importance: it provides a framework for estimating the value of water quality improvements for a substantial range of sites, and its site-specific orientation is especially relevant for water quality standards applications. Finally, it includes the effect of key site features--like access and facilities--and can use data frequently available in the public domain.

1.3.4 Approach Comparison

One of the primary objectives of this research has been to compare available approaches for measuring the benefits of water quality improvement. Such a comparison--reflecting the assumptions inherent in each approach--will show the plausibility of the required assumptions as descriptions of real-world behavior and constraints. However, since the "true" value of water quality improvement benefits is unknown, a comparison cannot be interpreted as a validation of any one approach. On the other hand, an evaluation of the comparability of estimates across approaches that considers the reasons for their consistencies and differences provides a basis for an improved use of benefit methodologies. Consistency also would give increased flexibility in matching a method to available data for each particular application.

Based on the research for the Monongahela River basin case study, the comparison between the travel cost and contingent valuation approaches is the most interesting. Estimates of benefits from water quality improvement are compared for the 69 users identified in the survey of households in the basin area. Previous comparisons of approaches relied on the use of mean estimates from each method. When these means are compared, it is assumed that all individuals can be treated as drawing from populations with the same mean benefits. Differences in individuals or error in the pairing of means can lead to a confounding of the benefit comparisons. In contrast, this study compared each household's user value, derived from the contingent valuation survey, with the corresponding estimate for that household from the travel cost model. Thus, this study gives a "more controlled comparison than was possible in earlier studies.

Table 1-1 shows the mean benefit estimates of user values for the travel cost and contingent valuation approaches. On theoretical grounds, the contingent valuation estimates of compensating surplus should be less than the travel cost estimates based on ordinary consumer surplus, but the differences should be slight due to the small income effects found in the research. However, this is not the case for three out of four contingent valuation estimates for improvements in water quality. Only the estimates derived with the $25 bidding game format are less than the travel cost estimates, although the travel cost estimates are within the range of contingent valuation estimates. For the loss of the area, the means comparison conforms to theoretical expectations, with the travel cost estimates larger than the contingent valuation estimates. Most of the differences between approaches exceed the size expected from theory. At best, simple comparisons of mean estimates--augmented by *a priori* information --are rough judgments of plausibility. On the basis of this compar-

Table 1-1. A Comparison of Mean Benefit Estimates (1981 Dollars)[a]

Approach	Water quality change[b]		
	Loss of area	Boatable to fishable	Boatable to swimmable
Contingent valuation			
Direct question	19.71 (17)	21.18 (17)	31.18 (17)
payment card	19.71 (17)	30.88 (17)	51.18 (17)
iterative bidding ($25)	6.59 (19)	4.21 (19)	10.53 (19)
iterative bidding ($125)	36.25 (16)	20.31 (16)	48.75 (16)
Generalized travel cost	82.65 (94)	7.01 (94)	14.71 (94)

[a]The travel cost estimates were converted from 1977 to 1981 dollars using the consumer price index for December 1981, the last month of the survey.

[b]The numbers in parentheses after the means are the number of observations on which each of these estimates was based. The number for the travel cost estimates exceeds the sum of the sample size for the contingent valuation results because some users visited more than one Monongahela River site.

ison, however, the Monongahela River basin estimates are plausible, but not precise.

A more discriminating comparison of the travel cost and contingent valuation approaches, one that judges how the two approaches compare across individuals, is also possible with the Monongahela River basin benefit estimates. In this comparison, presented in Table 1-2, the contingent valuation measure of user value was regressed on the travel cost estimate (see Chapter 8 for details). The a priori expectations of comparability in methods can be structured as two statistical tests. These models also take account of the effect of question formats used in the contingent valuation survey.

The results from the regression tests generally reinforce the earlier conclusions based on comparing the means estimated from each method. Several additional conclusions are possible from these comparisons:

- The contingent valuation estimates of water quality improvements overstate willingness to pay--in contrast to the theoretical expectations--but the results do not permit a judgment of statistically significant differences between the two sets of estimates. Some caution is required, however, because the properties of the statistical tests are approximate.

- The travel cost model overstates--by an amount greater than theory would predict--willingness to pay for the loss of the area, and the estimates are not comparable to the contingent valuation estimates.

Table 1-2. Regression Comparisons of Contingent Valuation and Travel Cost Benefit Estimates[a]

Independent variables	Water quality change: Loss of area	Boatable to game fishing	Boatable to swimming
Intercept	21.86 (1.37)	33.99 (1.90)	59.57 (2.02)
Travel cost-benefit estimate	0.33 (1.17) (-4.36)[b]	-3.67 (-1.20) (-1.71)[b]	-2.71 (-1.14) (-1.79)[b]
Qualitative variables			
Payment card	-32.64 (-2.55)	51.76 (2.64)	77.01 (2.36)
Direct question	-14.60 (-1.27)	12.96 (0.75)	21.00 (0.73)
Iterative bid ($25)	-31.82 (-2.55)	-11.24 (-0.60)	-21.82 (-0.69)
R^2	0.10	0.12	0.11
F	2.42 (0.05)[c]	3.00 (0.02)[c]	2.62 (0.04)[c]

[a]The numbers below the estimated coefficients are t-ratios for the null hypothesis of no association.

[b]These statistics are the t-ratios for the hypothesis equivalent to unity for the slope coefficient for Ordinary Consumer Surplus (OCS) after adjustment is made for the fact that Compensating Surplus (CS) is measured in 1981 dollars and OCS in 1977 dollars.

[c]The number in parentheses below the reported F-statistic is the level of significance for rejection of the null hypothesis of no association between the dependent and independent variables.

- The comparative performance of the contingent valuation approach in relationship to the travel cost method is sensitive to differences in question format--with the clearest distinctions found between the payment card and the bidding game with the $125 starting point.

- The explanatory power of the models used in the comparison are not high, but the null hypothesis of no association between methods is clearly rejected at high levels of significance (based on the F-tests reported at the bottom of the table).

1.3.5 Considerations for Future Research

The findings of this project also suggest that there are a number of areas for future benefits research, including both general and specific issues--especially those concerned with particular benefits measurement approaches.

General Issues

Option and existence values remain the most difficult general issues to address adequately. The research design for this project relied on the individual to divide the hypothetical option price payment into its user and option value components and then to add existence values to these option price bids as an incremental premium. Other studies (Brookshire, Cummings, et al. [1982] and Randall, Hoehn, and Tolley [1981]) have elicited preservation values--including both option and existence values--as additions to user values. Mitchell and Carson [1981] found user values by subtracting non-user's option price payments from user option price payments. Regardless of the procedures, however, all these studies have found option and existence values to be substantial--greater than half of the total benefits of environmental improvements. The choice among elicitation procedures, remains an open question.

One question that arises from the results of this and other recent studies of intrinsic benefits is, "Why worry about measuring option value when it is possible to elicit option price bids that include it?" Empirical estimates are of interest because of the controversy over the sign and magnitude of option value that has arisen in the theoretical literature. In addition, many practical applications of benefit methods do not measure intrinsic benefits, suggesting a need for empirical estimates to gauge the extent of the omitted portion of benefits from particular environmental policies. The early theoretical work seemed to imply (without explicitly stating this conclusion) that option values would be small in comparison to user values. Recent theoretical work by Freeman [1982] makes a case for positive option values and confirms this presumption by suggesting that option values should be small under almost all conditions. Only by attempting to distinguish between option and other intrinsic values will it be possible to bring some empirical evidence to bear on this question.

Proportional relationships between user and intrinsic values from earlier studies have often been used in attempts to infer the size of the omitted benefits when the intrinsic values are not directly estimated. The limited resources available for many public policy evaluations is the primary reason for the widespread use of the proportional approach. Since it is unlikely that these constraints on evaluations will ease in the future, more empirical research on the use and size of these proportions might be productive. For instance, determining how (and if) the proportions differ for certain classes of assets --ranging from unique natural environments to waterbodies with numerous substitutes--would provide useful guidance for applying these proportions. Moreover, attempting to distinguish between option and existence values for different classes of environmental assets may indicate the feasibility--and need--for such distinctions (see Fisher and Raucher [1982] for a review).

The research in this project has skirted another important issue--benefits aggregation. The travel cost model used in this project predicts recreation site benefits for "the representative" user. By assuming that all sites are possible substitutes (because one site's attributes can be "repackaged" to be equivalent to any other site), it implicitly maintains a simplistic view of the relationship between recreation sites within a region. Individuals always select the site providing the desired mix of attributes at the lowest implicit price. Clearly, not all sites adhere to these relationships. For example, a historical monument at the site may make it unique. What is needed is a more general characterization that would accommodate sites not conforming to the aggregation rule used to relate effective site services to site attributes. Such a framework would explain the relationship between an individual's patterns of site usage for facilities permitting very different types of recreation activities (e. g., water-based recreation versus skiing). Nevertheless, consistent regional and national benefit estimates will require a careful description of the interrelationships between the individual's demands for different types of recreation sites.

Another unresolved issue involves regional aggregation of local benefits estimated with the contingent valuation approach. Conventional practice in statistical surveys is to use statistical weights, which reflect the probability of selecting a particular sampling unit, to estimate aggregate benefits for the representative population (see Mitchell and Carson [1981]). However, this approach raises fundamental problems with the conventional practice in economic modeling that assumes common (and constant) parameters across individuals for correctly specified behavioral models. The definition of a representative sample is often based on a description of statistical models, leading to observed data that are at variance with conventional economic modeling. More research following the work of Porter [1973] is needed to consider the relevance of this issue for the extrapolation of contingent valuation estimates.

Another general research issue involves comparing alternative benefit estimation approaches. This project's comparison, which examines benefits predicted with the generalized travel cost model and contingent valuation willingness-to-pay estimates for the same individuals, permitted a fairly direct comparison of estimates with theoretical bounds. However, this study used estimates from only 69 users of the Monongahela River. A comparison having a larger number of users and based on a water-based recreation site with a greater diversity of users would provide a more revealing comparison. Indeed, following Bishop and Heberlein attempts to compare simulated market results with the results of this project also may shed light on the relationships among the estimation approaches. Before these comparisons are made, however, more systematic attention should be given to the theoretical underpinnings of the approaches, following the work of Schulze et al. [1981], Smith and Krutilla [1982], and Bockstael and McConnell [1982].

Future research should also reconsider the economic principles underlying comparisons of economic welfare--particularly the measurement basis (ordinary consumer surplus and the more precise Hicksian-based measures). The comparisons made in this project have involved expenditures of such a small percentage of individuals' budgets that the differences between the measures is insignificant. Since some, and perhaps many, environmental issues may involve large price and quantity changes with more significant income effects, the empirical application of various measures becomes significant. Bockstael and McConnell [1980] have raised some empirically based issues, but a more extensive effort such as Willig's [1976], comparing recent approaches proposed by Hausman [1981], McKenzie and Pearce [1982] , and Takayama [1982], may yield guidance for applications with these large changes.

A final general issue on the research agenda that, unfortunately, was beyond the scope of this project--and too many other benefits analyses--is the distribution aspect of benefit policies. By neglecting distribution concerns, economists are unable to appreciate many policy objections expressed in the political arena. For example, attention to the distributional effects of alternative water pollution policies would be a valuable complement to the efficiency-oriented questions that constitute the primary focus of benefits analysis. Further rationale for such efforts stems from Executive Order 12291, which recognizes the importance of distribution effects by requiring them in regulatory impacts analyses.

The future research agenda for the individual benefits estimation approaches contains items ranging in subject from experimental design and sampling to the behavioral models that underlie several approaches. Some of the agenda items are already being studied in various quarters, while others will involve substantial funding --e.g., basic data collection--for any progress to be made.

Specific Research Issues

The travel cost model developed in the project raises as many research questions as it answers. The main answer is that the model can be used to estimate the benefits of water quality improvements in a way consistent with economic theory.* However, many problems were encountered on the way to answering this fundamental question. For example, in the survey data used to estimate the travel cost model, as in many surveys involving noneconomic data, the data were heaped at specific points, possibly presenting problems for ordinary least-squares regression analysis. Specifically, all visitors who made only one visit to a site were heaped at the zero point for the logarithmic transformation of the dependent variable, while the visitors who made the maximum were heaped at the other end point. The maximum is the value (8) assigned to the open interval for five or more visits. The remaining visitors were arrayed at specific intervals in between. The need, obviously, is for a statistical estimator that can handle this problem. In terms of the absolute magnitude of the estimated values, which is important for estimating benefits, the differences may be small, but this is a fundamental question requiring statistical analysis rather than judgment. Equally important, the fact that all respondents have used the site at least once implies that this study fails to consider the demands of individuals whose maximum willingness to pay falls below their travel cost. This truncation can, as suggested in the report, lead to biased estimates of

*This is one of the items on Freeman's [1979a] research agenda cited earlier.

site demands. It is important to evaluate the implications of amending the statistical models to directly account for these effects for the benefit estimates derived for water quality improvements.

Many of the items on the travel cost research agenda stem from limited data. This project used the 1977 Outdoor Recreation Survey's Federal Estate component, which surveyed visitors at various recreation sites on Federal lands. Although in many ways these data are far better than those in earlier survey efforts, they omit many items important for the travel cost model. For example, there were no questions on substitute sites that respondents had considered--or even visited at other times--before visiting a particular site. While the generalized model assumes that site attributes are capable of reflecting substitution potential, the model would be considerably improved if it had a better measure of substitutes.

The travel cost model also assumed that the sole purpose of an individual's trip was to visit a particular site. However, Haspel and Johnson [1982] point out the potential for overstating benefits when there are multiple purposes for a trip, suggesting the need for more research using itinerary information to assess the importance of multipurpose trips. Also needed for the travel cost model are more data on the types of time allocations the individual considered in making the trip. For example, was work time forgone or compulsory vacation time? Each may have a different opportunity cost. With answers to these questions, it will be possible to improve the calculation of an individual's time costs for recreation.

Including site attributes in the travel cost model created several data-related questions. Specifically, because water quality data from the standard storage system (STORET) were inadequate for many recreation sites, observations were missing on key parameters, and the monitoring station information was frequently unreliable. Clearly, more comprehensive data are needed, especially for water quality parameters relevant to recreation activities. Data on other site attributes such as access or size were available for the U.S. Army Corps of Engineers' sites through the Corps' Resource Management System. However, to apply the model to other recreation sites--e. g. , sites managed by the U.S. Forest Service--would require similar information on important site attributes. Present! y, such data are not readily available.

The future research agenda for the contingent valuation approach is aimed at a more systematic treatment of issues involving the design of the hypothetical market. The research questions are in the general area that economists have termed "framing the question" (see Brookshire, Cummings, et al. [1982])--an area generally called "context" in the psychological literature. The definition of the commodity to be valued, the question format used to elicit the value, the ordering of various valuation and nonvaluation questions, the means of payment in the market, and the information provided in the survey questionnaire are all important elements in this framing process. More attention to these issues is likely to substantially improve the understanding of the approach and provide results that are easier to interpret.

This project addressed several general contingent valuation issues by comparing several question formats -- bidding games with two starting points, direct question, and the unachored payment card--both to each other and to results from the contingent ranking format. Different payment cards, such as the anchored card used by Mitchell and Carson [1981], were not compared. In addition, the contingent ranking format was always used in conjunction with another question format, which limits the independence of the conclusions. Both of these are good candidates for future research.

This survey was conducted in a specific river basin, making the orientation more micro in scope than Mitchell and Carson's [1981]. A more systematic comparison of their results for overall national water quality and the results of this study for the Monongahela River basin may be useful. Moreover, the general framing questions are especially relevant to the macro approach, where it is more difficult to define the hypothetical commodity. If policy decisions require basin-specific results, either specific surveys (or the ability to transfer results between basins) or the ability to infer estimates for specific river basins from the macro approach will be required.

Recently, Brookshire, Cummings, et al. [1982] introduced the ideas of environmental accounts and budget constraints as part of the framing issue. The accounts question aims at determining whether people give an overall environmental quality bid in a survey or a bid for the specific hypothetical commodity. The budget constraint requires that individuals provide rough budget shares for their monthly incomes and then reallocate these categories to provide the budget amount for the hypothetical commodity. The preliminary results in Brookshire, Cummings, et al. [1982] suggest this is a useful avenue for learning more about framing influences.

Finally, improving efficiency in defining hypothetical markets is a neglected area in the contingent valuation literature. One promising approach is the use of focus groups (from market research literature) to obtain impressions about terminology, visual aids, and other framing issues. Applying these marketing research ideas to contingent valuation may indicate their overall merits.

Research agendas must continually evolve, producing new avenues from deadends that once offered promise. The present agenda tries to map some of these new avenues. The passage of time and the fruits of future research will mark its ultimate usefulness.

1.4 GUIDE TO THE REPORT

This chapter has introduced the report by highlighting the project objectives and summarizing the findings of the research. Chapter 2 provides a brief review of some of the theoretical issues of comparing alternative benefit estimation approaches. After describing the Monongahela River basin, Chapter 3 summarizes the sampling and survey plans for the contingent valuation and contingent ranking approaches used in the case study. Chapter 4 builds on the contingent valuation foundation laid in Chapter 3 by presenting the research design for the contingent valuation survey, by profiling key groups of respondents, and by summarizing the empirical option price results, including the effects of question format, starting point, and interviewer bias. Chapter 5 synthesizes the theoretical underpinnings of option value, giving particular attention to the role of supply uncertainty, and presents empirical results for both option and existence values. Chapter 6 reviews the theory underlying the contingent ranking approach, provides a critical summary of its previous applications, considers appropriate measures of benefits, and summarizes the empirical findings from its application to the Monongahela River basin. Chapter 7 presents the development of a generalized travel cost model and describes its application to predict the recreation benefits of water quality improvements in the Monongahela River. The development of the model treats the empirical significance of model specification, site time costs, simultaneity in visit/site time decisions, and statistical biases in its predicted values. Chapter 8 compares the alternative approaches for estimating recreation and related benefits, in light not only of previous comparison attempts but also of a *priori* expectations. In addition, Chapter 8 also describes paired comparisons of the contingent valuation and travel cost approaches and of the contingent valuation and contingent ranking approaches using multivariate regression techniques.

CHAPTER 2

A BRIEF REVIEW OF THE CONCEPTUAL BASIS FOR THE BENEFIT ESTIMATION APPROACHES

2.1 INTRODUCTION

An ideal comparison of benefit estimation approaches would begin with a detailed theoretical appraisal of each approach, showing how each is derived from a common conceptual framework. However, this kind of appraisal is beyond the scope of this project. Instead, this chapter highlights the assumptions, information, and types of benefits measured by each of three approaches and compares these features on general, rather than on common, theoretical grounds.

The definition of economic benefits based on theoretical welfare economics has closely followed the model of consumer behavior, which suggests that individuals can acquire utility only through consuming goods or services. This framework leads to definitions of economic benefits best suited for describing user benefits associated with improvements in environmental quality. However, since the work of Krutilla [1967], nonuser, or intrinsic, benefits have been increasingly recognized as playing an important role in the aggregate values for certain environmental resources.

Intrinsic benefits are generally viewed as arising from two sources. The first source suggests that an individual can realize utility without direct consumption of a good or service. Rather, other motives can be satisfied with allocation patterns for certain resources, and these motives --"stewardship" and "vicarious consumption" in Freeman's [1981] terms--can lead to utility, therefore providing nonuser benefits. An alternate view can be derived by redefining the act of consumption to admit what might be considered indirect use of the services of an environmental amenity.

The second source of intrinsic benefits is derived by relaxing one of the assumptions underlying conventional consumer behavior models. The simplest treatment of the conditions for efficient resource allocation assumes that all goods and services--whether they provide positive increments to utility or decrease it--are available with certainty. Of course, this is not the case in the real world. Indeed, in some circumstances--e. g. , the degree of reversibility in water quality conditions--uncertainty may well be the most important element of the public policy problem. In these cases, therefore, consumer behavior models must be amended to reflect how households react to uncertainty and whether they would be willing to pay for action that would reduce it.

A second relevant feature of the definitions of economic benefits presumably arises from the early focus on goods or services exchanged in private markets. These definitions developed measures of benefits for price changes. Since environmental policy has dealt mostly with quantity (or quality) changes in services provided outside of private markets, these measures must be adapted to meet policy needs.

The purpose of this chapter is to briefly review the theoretical concepts generally used in measuring economic benefits, Specifically, Section 2.2 deals with the theoretical basis of benefit measurement based on the concept of an individual's willingness to pay and describes alternative ways to measure changes in consumer welfare. Section 2.3 outlines the framework for comparing different benefit estimation approaches--an adaptation of the Smith-Krutilla [1982] framework for classifying the different approaches and summarizing their conceptual bases. Section 2.4 describes the welfare measurement bases underlying the two benefit estimation approaches compared in this study -- travel cost and contingent valuation (including the contingent ranking format). Finally, Section 2.5 prvides a brief summary.

2.2 A BRIEF REVIEW OF THE CONVENTIONAL THEORY OF BENEFITS MEASUREMENT

The primary emphasis for this study of recreation and related benefits of water quality improvements focuses on the measurement of benefits that accrue to individual households. Fortunately, the theory of consumer behavior provides a framework for measuring these benefits. This section briefly reviews this framework to set the stage for the comparison of approaches that follows.

The first guidepost for the definition and measurement of economic benefits that the theory of consumer behavior provides is the individual demand function, shown in Figure 2-1. This function describes for any good, X, the maximum amount an individual would be willing to pay for each quantity of X. The downward slope of the curve indicates that individuals are willing to buy more of X at lower prices than they are at higher prices. The simple two-dimensional diagram in Figure 2-1 assumes all other factors that might influence demand -- income, the prices of related goods, etc. --do not change. Thus, according to the demand function, if the market leads to a price of P_o, the individual will purchase Q. of X and make a total expenditure equal to POAQOO. Since the demand curve measures the individual's maximum willingness to pay for each level of consumption, the total willingness to pay for Q. can be derived--total expenditures plus the triangle P_0P_iA. This difference between the amount they are willing to pay and what individuals actually pay with a constant price per unit is defined as the consumer surplus--the conventional dollar measure of the satisfaction individuals derive from consuming a good or service, exclusive of what they pay for it.

As a dollar measure of individual welfare, however, consumer surplus is not ideal. The most direct way of understanding its limitations is to consider

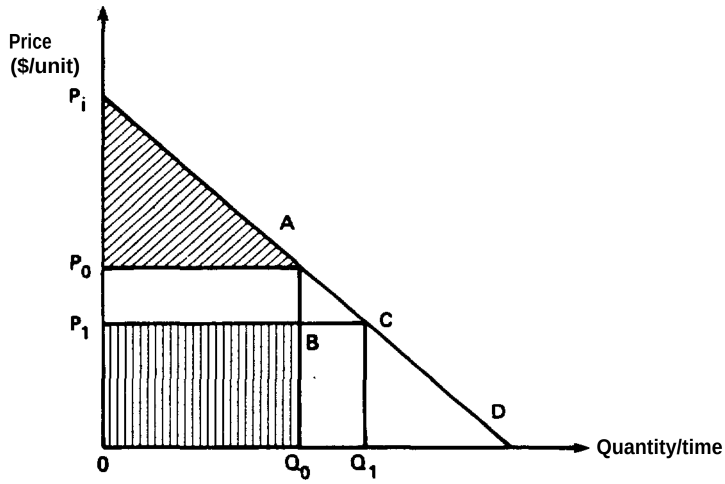


Figure 2-1. The demand function and the consumer surplus welfare measure,

the measurements underlying a conventional demand function. An individual's demand function describes the maximum an individual with a given nominal income would be willing to pay for each level of consumption of a particular good. Specifically, if the price paid changes, it will affect not only what the individual can purchase of this good, but also the purchases of all other commodities through its effect on the remaining disposable income. Thus, movement along a conventional demand function affects the level of satisfaction an individual will be able to achieve with a given income. For example, suppose the price of hypothetical good X declines to P_1. The individual can purchase the same quantity of X at its new price as indicated in Figure 2-1 by the area OP_1BQ_0 and have income remaining, as given by P_1P_0AB, to purchase more X or more of other goods and services. The movement to a consumption level of OQ_1 describes the increased selection of X under the new price. This change leads to a higher utility level because more goods and services can be consumed with the same income. For consumer surplus to provide an "ideal" dollar measure of individual well-being, however, the conversion between dollars and individual utility levels must be constant for every point on the demand curve. According to this example, then, each point on a conventional demand function in principle corresponds to a different level of utility. Thus, no single conversion factor links consumer surplus and utility.

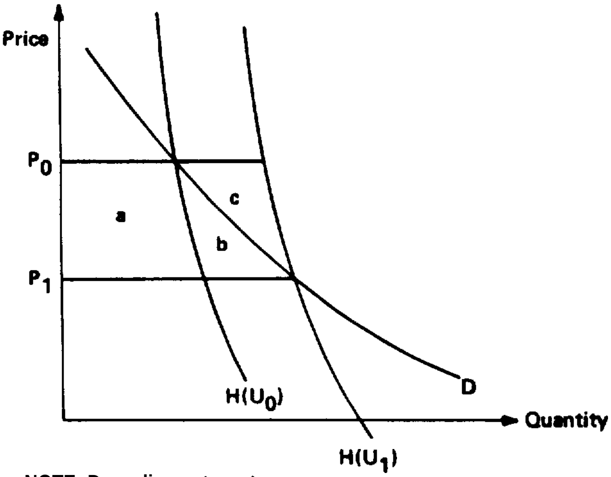
In his seminal work on consumer demand theory, Hicks [1943] noted that an ideal measure would require that utility be held constant at all points along the demand curve. As a practical matter, however, the difference between the area under such an ideal, Hicksian-based demand curve and that under a conventional demand curve depends on the size of the income effects accompanying the price changes associated with movements along the ordinary demand curve. As suggested earlier, price reductions lead to more disposable income. To judge the association between the two measures of welfare change, all aspects of the choice process that affect the size of the change in disposable income must be considered. For example, if the price change for X is small and the share of the budget spent on the good X is also small, the change in disposable income is likely to be small. Thus, little difference will exist between the ordinary measure of consumer surplus and the measure derived from Hicks' idealized demand curve. However, the same outcome arises either if income has little effect on the demand for X or if an individual's preferences are such that the demand responsiveness to income is equal for all goods (i. e., unitary income elasticities of demand).

Of course, each of the conditions described above is a special case. When ordinary demand functions are used to measure the benefits of an action in practical applications, the factors influencing the demand function's relationship to an ideal dollar measure of welfare change must be identified. Fortunately, Willig [1976] and Randall and Stoll [1980] have derived such guidelines for cases involving price and quantity changes, respectively. To understand these guidelines, the possible theoretical measures of individual welfare change must first be defined in more precise terms.

Hicks' [1943] theoretical analysis of measures of welfare change provides the basis for developing a set of rigorous measures and, with them, the error bounds for ordinary consumer surplus. The four Hicksian welfare measures for a price decrease are summarized below:

- Compensating variation (CV) is the amount of compensation that must be taken from an individual to leave him at the same level of satisfaction as before the change.
- Equivalent variation (EV) is the amount of compensation that must be given to an individual, in the absence of the change, to enable him to realize the same level of satisfaction he would have with the price change.
- Compensating surplus (CS) is the amount of compensation that must be taken from an individual, leaving him just as well off as before the change if he were constrain-cd to buy at the new price the quantity of the commodity he would buy in the absence of compensation.
- Equivalent Surplus (ES) is the amount of compensation that must be given to an individual, in the absence of the change, to make him as well off as he would be with the change if he were constrained to buy at the old price the quantity of the commodity he would actually buy with the new price in the absence of compensation.

As a simplified comparison, Figure 2-2 highlights the essential differences between the Hicksian variation measures and the ordinary consumer surplus measures when the price of a good decreases. The two Hicksian demand curves holding utility constant (at levels U_0 and U_1 with $U_1 > U_0$) are shown as $H(U_0)$ and $H(U_1)$, the prechange and postchange levels of utility, respectively. The ordinary demand curve--also known as the Marshallian demand curve --is shown as D, where income, and not utility, is held constant. The

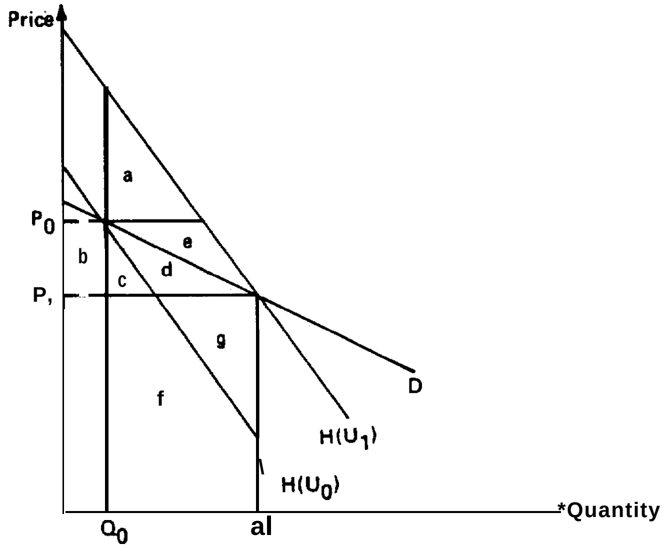


NOTE: D - ordinary demand curve
H(IJO), $H(U_1)$ = Hicksian demand curves
Ordinary consumer surplus = a + b
Compensating variation = a
Equivalent variation = a + b + c

Figure 2-2. A comparison of alternative welfare measures.

compensating variation measure, labeled as area a, uses the original level of utility as its reference point and indicates the amount of compensation that must be taken from an individual to leave him at the original level of utility when the price changes from P. to PI. The equivalent variation measure is represented by area a+b+c. It measures the change in income equivalent to the change in prices and thereby permits an individual to realize the new level of utility with old price P_o. The change in ordinary consumer surplus is the area under the ordinary demand curve, D, between P. and PI. In Figure 2-2 it is shown as areas a+b.

The concepts of compensating surplus and equivalent surplus were originally defined as measures of the welfare change resulting from a price change, given that the quantity of the good whose price has changed is not allowed to adjust. However, it is also possible to interpret these concepts as measures of the welfare change associated with a quantity change (see Randall and Stoll [1980]). Just, Hueth, and Schmitz [1982] have recently offered a diagrammatic illustration of compensating and equivalent surplus in a format similar to that used above to describe compensating and equivalent variation. However, in the present example, the price is assumed constant at some arbitrarily low value (effectively zero for Figure 2-3), and D is interpreted as an ordinary demand curve (i. e., as if the quantities consumed could be realized only at the corresponding prices and not the constant price). In Figure 2-3 a change in the quantity of the good available from Q. to Q_1leads to a compensating surplus of c+f and an equivalent surplus of a+e+c+d+f+g. The ordinary consumer surplus- is c+d+f+g, which is d+g more than the compensating surplus measure and a+e less than the equivalent surplus.



Source: Just, Hueth, and Schmitz [1982].

Note: Ordinary consumer surplus - c + d + f + g
Compensating surplus = c + f
Equivalent surplus = a + e + d + c + f + g

Figure 2-3. Surplus measures for a change in quantity.

Table 2-1 relates the welfare measures under different conditions of willingness to pay/accept, showing quite clearly that no one unique measure exists. Rather, the appropriate measure is determined by the particular situation. Table 2-1 reinforces this point by presenting the types of welfare measure in relation to different situations. For a price decrease, for example, the following relationship holds between the alternative welfare measures:

$$ES > EV > CV > CS .$$

For a quantity increase, the equivalent surplus measure will be greater than the compensating surplus measure. The primary reason for the differences between welfare measures is that the equivalent surplus and equivalent variation are not bounded by' an individual's income constraint, while the compensating variation and compensating surplus measures are. It should also be noted that the measures are symmetrical and that, for a price increase or quantity decrease, the relationship between the measures is exactly the reverse.

It is important to recognize that the compensating and equivalent measures of welfare changes differ because they imply a different assignment of property rights to the individual and therefore are based on different corresponding frames of reference. For example, with a price decrease, the compensating variation measure takes the initial price set as an individual's frame of reference and asks, in effect, "What is the maximum amount he would be willing to pay to have access to the lower prices?" By contrast, equivalent variation takes the new, lower price set as an individual's frame of reference and

Table 2-1. Alternative Welfare Measures and Types of Consumer Surplus Measures for Contingent Valuation Studies

	Price decrease	Price increase	Quantity increase	Quantity decrease
WTP	CV; CS	EV; ES	CS	ES
WTA	EV; ES	CV; CS	ES	CS

NOTE:

CS is the amount of compensation that must be taken from an individual, leaving him just as well off as before the change if he were constrained to buy at the new price the quantity of the commodity he would buy in the absence of compensation.

CV is the amount of compensation that must be taken from an individual to leave him at the same level of satisfaction as before the change.

ES is the amount of compensation that must be given to an individual, in the absence of the change, to make him as well off as he would be with the change if he were constrained to buy at the old price the quantity of the commodity he would buy in the absence of compensation.

EV is the amount of compensation that must be given to an individual, in the absence of the change, to enable him to realize the same level of satisfaction he would have with the price change.

WTA is the amount of money that would have to be paid to an individual to forego the change and leave him as well off as if the change occurred.

WTP is the amount of money an individual will pay to obtain the change and still be as well off as before.

describes the minimum amount an individual would be willing to accept to relinquish his right to the lower price. These measures bound the range of dollar values for the welfare changes because they describe the results obtained from the perspectives of the initial utility level and the final utility level. Consequently, Willig [1976] uses this feature to establish conditions under which conventional consumer surplus would approximate "ideal" measures for the welfare change associated with a price change. Moreover, Randall and Stoll [1980] follow essentially the same logic to gauge the relationship between ordinary consumer surplus measures for a quantity change and the corresponding compensating and equivalent surplus measures.

Equations (2.1) and (2.2) provide the basis for the Willig bounds for the difference between the ordinary consumer surplus measure and the equivalent variation and compensating variation measures of a change in welfare due to a price change: *

$$\frac{CV - OCS}{|OCS| \cdot 2} \simeq \frac{|OCS|\ N}{M} , \qquad (2.1)$$

$$\frac{OCS - EV}{|OCS| \cdot 2} \simeq \frac{|OCS|\ N}{M} , \qquad (2.2)$$

where

OCS = ordinary consumer surplus measure of welfare change

N = income elasticity of demand = $\frac{\Delta Q}{Q} / \frac{\Delta Y}{Y}$

M = initial level of income.

These relationships can be evaluated at different values for the income elasticity of demand over the region for the price change and thereby provide bounds for the magnitude of the discrepancy between 'ordinary consumer surplus and the equivalent and compensating variation welfare measures. Equations (2.1) and (2.2) assume that the income elasticity of demand (N) is approximately constant over the region for the price change (see Willig [1976], pp. 592-593, for a discussion). If this assumption is relaxed, the bounds can be stated as inequalities for the percentage difference between ordinary consumer surplus and the corresponding measures of welfare, as in Equations (2.3) and (2.4):

$$\frac{|OCS|\ N_S}{2M} \leq \frac{CV - OCS}{|OCS| \cdot 2} \leq \frac{|OCS|\ N_L}{M} , \qquad (2.3)$$

$$\frac{|OCS|\ N_S}{2\ M} \leqq \frac{OCS - EV}{|OCS|} \leqq \frac{|OCS|\ N_L}{2\ M} , \qquad (2.4)$$

where

N_S = the smallest value of the income elasticity of demand over the region for the price change

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*It is important to note that the direction of the price change affects the sign of ordinary consumer surplus, compensating variation, and equivalent variation and, thus, the interpretation of Equations (2.1) through (2.4). This formulation "adopts Willig's convention that ordinary consumer surplus is positive for a price increase and negative for a price decrease so that it corresponds to the interpretation of compensating variation or equivalent variation. See Willig [1976], p. 589.

ϵ_L = the largest value of the income elasticity of demand over the region for the price change.

The Willig approximation is reasonable if the value of $\frac{|OCS| N}{2 M} \leqq 0.05$ If this value is greater than 0.05, Willig has provided a table of error bounds based on the relationships used to derive these approximate bounds. *

2.3 A FRAMEWORK FOR COMPARING ALTERNATIVE BENEFIT MEASUREMENT APPROACHES

Comparing alternative approaches for estimating the recreation and related benefits of water quality improvements at first seems formidable because of the wide range of consumer behavior outcomes described by each. However, despite this diversity, all approaches adhere to a consistent general model of consumer behavior: individuals allocate their monetary and time resources to maximize their utility subject to budget and time constraints. As noted at the outset, a complete comparison of the methods could derive each method from this common conceptual basis. However, this section simply provides a taxonomic framework that eases the comparison of approaches by drawing clear distinctions between the assumptions underlying each.

Figure 2-4 presents the Smith-Krutilla [1982] framework for classifying the alternative approaches for measuring the recreation and related benefits of water quality improvements.
changes in water quality and observable actions of economic agents that affect the information available for measuring water quality benefits. In particular, Smith and Krutilla suggest that all approaches for measuring the benefits of a change in an environmental resource can be classified as involving either physical or behavioral assumptions.

The category associated with physical assumptions in this framework maintains that the association between the environmental service of interest (i.e. , water quality) and the observable activities (or changes in goods or services) is a <u>purely</u> <u>physical</u> relationship. The responses are determined by either engineering or technological relationships. Thus, the evaluation of water quality changes in such a framework must begin by identifying the activities affected by water quality. Analysis must then focus on measuring the technical relationships, sometimes referred to as damage functions, assumed to exist between water quality and each activity. Because water quality improvements can be associated with the support of gamefish, swimming, and the use of water for human consumption, the physical approach seeks to specify the technical linkages between water quality levels and permitted amounts of recreation fishing, swimming, and water consumption. Another example of the

*Two excellent discussions of the practical implications of the Willig bounds for benefit measurement are available in Freeman [1979a], pp. 47-50, and in Just, Hueth, and Schmitz [1982], pp. 97-103.

	Types of Linkage Between Water Quality Change and Observed Effects		Types of Assumptions Required	Measurement Approaches
No Role for Behavioral Responses of Economic Agents	Physical Linkages		Responses are determined by engineering or "technological" nsh ps	Damage Function
Behavioral Responses of Economic Agents Are Essential	Behavioral Linkages	Indirect Links	Restrictions on the nature of individual preferences OR observed technical associations in the delivery of goods or services	Hedonic Property Value Travel Cost*
		Direct Links	Institutional	Contingent Valuation* (including Contingent Ranking*)

*Approaches compared in this study.

Figure 2-4. Smith-Krutilla framework for classifying the measurement bases and approaches of economic benefits resulting from improved water quality.

physical approach to evaluating the effects (and, ultimately, the benefits) of a water quality change can be found in the dose-response models used to evaluate the health risks associated with certain forms of water pollution (see Page, Harris, and Bruser [1981] for a review of these models). Although these models ignore economic behavior and postulate that the relationships involved can be treated independently of the motivations of economic agents, they may well provide reasonable approximations of the actual effects on water quality for certain classes of impacts. However, these models are unlikely to be adequate when economic agents can adjust their behavior in response to the water quality changes and, as a result, are not considered in this study.

The behavioral category of valuation methodologies in the Smith-Krutilla framework relies on the observed responses of economic agents and on a model describing their motivations to estimate the values (or economic benefits) associated with a change in a nonmarketed good or service. Within this class, direct or indirect links identify three classes of assumptions that can be used to develop measures of individual willingness to pay. The first type of assumption used -within the indirect behavioral framework requires restrictions on the nature-of the individual's utility function and is usually associated with Mäler's [1974] weak complementarily. This type of assumption maintains that an individual's utility function is such that there is a specific association between the nonmarketed good (or service) and some marketed commodity such that the marginal utility of an increment to the consumption of the nonmarketed good is zero when the individual is not consuming some positive amount of the associated, marketed commodity. This assumption maintains that a type of "jointness" exists in the formation of the individual's utility, which, in turn, constrains the feasible responses to Price changes for the marketed good (or changes in the availability of the nonmarketed good). Thus, the selection of the two goods is joint, and market transactions for one good can be used to determine demand for the other. Of course, this approach depends upon the plausibility of the restriction on an individual's utility function. Researchers have used this restriction to justify both hedonic property value and travel cost studies.

Smith and Krutilla [1982] argue that the weak complementarily behavioral restriction is not necessary for these approaches and that the observed technical associations between marketed and nonmarketed goods are responsible for the abi lity to use these methods to measure benefits of changes in a nonmarketed good. In the case of the technical assumptions, the availability of the nonmarketed service is tied to some marketed good by the nature of its natural delivery system, making the linkage an observable phenomenon rather than a feature of an individual's preferences. For example, water-based outdoor recreation is undertaken using the services of recreation sites on rivers or lakes. Each recreationist is interested in the water qualities only at the sites considered for his recreation use. By selecting a site for these activities, an individual is also selecting a water quality, because the two are "technically linked" or jointly supplied. Thus, where there is a range of choice (i. e., several different combinations of recreation sites and water quality), how an individual values the nonmarketed good or service can be seen through his observable actions, including such decisions as the selection of a residential location or visits to specific recreation facilities (see Rosen [1974] and Freeman [1979c]). This study specifically considers the travel cost method, which uses this technical association as its basis for measuring water quality benefits.

The last case of behavioral approaches to benefit estimation involves direct linkages between water quality and an individual's actions. The assumptions made to ensure these linkages are labeled institutional, a designation somewhat more difficult to understand than previous descriptions because it encompasses the contingent valuation and contingent ranking methods for measuring an individual's valuation of environmental amenities. Specifically, the institutional assumptions arise because the analyst assumes that individual responses to hypothetical decisions (or transactions) are completely comparable to individual responses revealed in actual transactions. The term institutional is used for this class because the organized markets in which goods and services are exchanged are institutions that provide the information on individuals' marginal valuations of the commodity involved. With the survey approach, the interviewer poses the survey questions to construct an equivalent institutional mechanism in the form of a hypothetical market. Both the contingent valuation and the contingent ranking methods will be considered under this approach.

2.4 THE NATURE OF THE BENEFITS MEASURED IN THE ALTERNATIVE APPROACHES

This section highlights the nature of the benefits measured in the travel cost and contingent valuation approaches.

2.4.1 Travel Cost Appreach

The travel cost approach measures the change in ordinary consumer surplus for a water quality improvement, represented for an individual incurring travel costs per trip of OPl by area ABCD in Figure 2-5. To empirically develop the ordinary consumer surplus estimate, the travel cost approach assumes both that travel to a recreation site reveals a respondent's reservation price for that site's services and that water quality is jointly supplied along with the other site attributes. If other variables are held constant, and if sites are placed on a common measurement scale, * area ABCD can be measured by observing individuals' site selections across sites with varying levels of water quality, thus revealing the effect of water quality on site demand. Therefore, while both Freeman [1979b] and Feenberg and Mills [1980] maintain that conventional travel cost models cannot measure benefits associated with water quality change, ? the generalized travel cost model developed for this

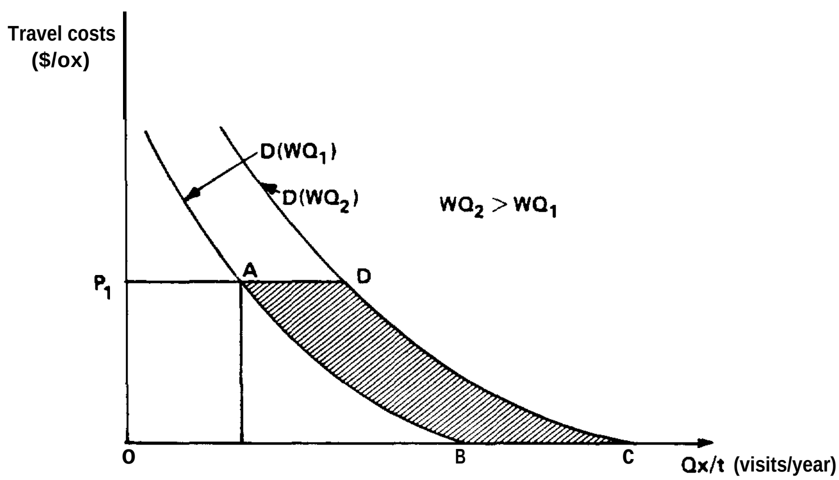

Figure 2-5. Travel cost demand function with water quality improvement.

*The rationale for this measurement approach is presented in more detail in Section 7.3.

†Their models do not gauge the demand change that accompanies a water quality change.

study (see Chapter 7) uses the responses of individuals at different locations to both travel cost and water quality levels to infer benefits of water quality changes. The information provided by these responses allows the change from $D(WQ_1)$ to $D(WQ_2)$ in Figure 2-5 to be distinguished (where WQ_1 and WQ_2 represent different levels of water quality, with $WQ_2 > WQ_1$).

2.4.2 Contingent Valuation Appreach

The contingent valuation approach directly measures an individual's willingness to pay for water quality in an institutional arrangement that approximates the market for water quality. Unlike the travel cost approach, contingent valuation does not require observations of individuals' decisions on use of recreation sites with given "implicit" service prices, but it does assume an individual's response in the hypothetical market is the same as it would be in a real market. That is, respondents are assumed not to behave strategically, not to give unrealistic responses, and not to be influenced by the survey questionnaire or the interviewer who administers the survey questionnaire. Furthermore, the contingent valuation approach imposes an institution that leads to a hypothetical change in an individual's budget constraint by requiring that the individual "pay" for the specified water quality improvement. Thus, the new budget constraint for the utility maximization process includes both the prices and quantities of market goods and the hypothetical price and defined quantity of water quality.

The institutional design underlying contingent valuation surveys requires that ownership of the property rights for water quality at the recreation site be determined in the specification of the question, thus affecting the appropriate measure of consumer welfare. Specifically, consumer ownership of property rights would indicate a willingness-to-accept measure as the appropriate valuation concept, and industry ownership would dictate a willingness-to-pay measure. Although currently boatable throughout, the Monongahela River--the site used for this study (see Chapter 3)--supports swimming and fishing only upriver from Pittsburgh, and property rights are in a state of flux with considerable confusion over ownership (see Feenburg and Mills [1980]). Thus, a reasonable allocation for this study's survey of Pittsburgh residents is that consumers own the rights to beatable water (which suggests an equivalent surplus measure), while no one yet owns the rights to fishable, swimmable water along the entire river (which indicates a compensating surplus measure).

While using a willingness-to-accept measure for maintaining a boatable water quality level and a willingness-to-pay measure for the value of moving to fishable and swimmable levels is consistent with current Monongahela property rights, willingness-to-accept measures have proven difficult in hypothetical market experiments, thus creating serious problems in the development of a workable survey methodology. For example, respondents have either refused to answer, given infinite bids, or refused to accept any compensation for reductions in environmental quality [Schulze, d'Arge, and Brookshire [1981] and Bishop and Heberlein, 1979]. To cope with this problem, this study employs a willingness-to-pay (equivalent surplus) measure for the decrease from boatable water quality and a compensating surplus measure for improvements from the same level.

2.4.3 Continent Ranking Approach

Like the other contingent valuation formats, contingent ranking relies on individuals' responses in a hypothetical market situation. However, instead of requiring an individual to respond with the maximum willingness to pay for a water quality improvement, contingent ranking requires that individuals rank outcomes--consisting of a hypothetical payment and a corresponding level of water quality--from most preferred to least preferred. The implicit argument underlying contingent ranking is that an individual is better able to respond to the hypothetical market when both outcomes are specified. In the utility maximization framework underlying the contingent ranking approach, an individual ranks the alternatives based on their implications for his ability to maximize utility with a given income, the prices of other goods, and the proposed combination of payment and water quality. Analytically, this choice can be described by comparisons of the indirect utility functions arising from each of these sets of decisions. An appropriate compensating surplus measure can then be derived from estimates of the indirect utility function.

2.5 Summary

Partly because they are all based on the common standard of constrained utility maximization, the travel cost, contingent valuation, and contingent ranking approaches can each develop measurements of changes in consumer welfare. The travel cost approach measures the change in ordinary consumer surplus, the contingent valuation approach measures equivalent and compensating surpluses, and the contingent ranking format yields a compensating surplus welfare measure.* The relationship between each of these methods' measures of the welfare changes associated with water quality changes is considered in the comparison analysis reported in Chapter 8.

*It should be noted that, for the contingent valuation approaches, questions have been formulated to include both user and nonuser values. Strictly speaking, both approaches measure the option price, but the contingent valuation approach permits the user value component to be identified.

CHAPTER 3

SURVEY DESIGN

3.1 INTRODUCTION

Estimating the recreation and related benefits of water quality improvement with the contingent valuation approach requires an integrated survey design. This chapter describes the survey design for the case study of the Monongahela River. Specifically, Section 3.2 describes the general background of the Monongahela River basin area, Section 3.3 highlights the sampling plan for the project, and Section 3.4, a discussion of the survey plan, concludes the chapter with detailed information on the survey field procedure.

3.2 GENERAL DESCRIPTION OF THE MONONGAHELA RIVER BASIN

This section describes the Monongahela River basin, providing a general description of river geography, river uses, river-related recreation activities, and a socioeconomic profile.

3.2.1 Geography

Formed by the confluence of the West Fork and Tygart Rivers near Fairmont, West Virginia, the Monongahela River drains an area of 7,386 square miles in southwest Pennsylvania, northern West Virginia, and northwest Maryland. (See Figure 3-1 for a map of the area.) It flows northerly 128 miles to Pittsburgh, where it forms the Ohio River headwaters with the Allegheny River, and has two major tributaries, the Youghiogheny and Cheat Rivers. All 128 miles of the Monongahela are navigable year round by motorized commercial traffic.

Characterized by steep banks and rugged terrain, the Monongahela River basin lies in five Pennsylvania Counties (Allegheny, Greene, Fayette, Westmoreland, and Washington) and two West Virginia counties (Monongalia and Marion) in the Appalachian Plateau and the Allegheny Mountains. The Monongahela basin currently supports four major reservoirs:

- Deep Creek Reservoir--A privately owned Maryland facility operated on a Youghiogheny River tributary to generate 51 megawatts of electric power.

- Lake Lynn Reservoir--A privately owned West Virginia facility operated on the Cheat River to produce 19 megawatts of electric power.

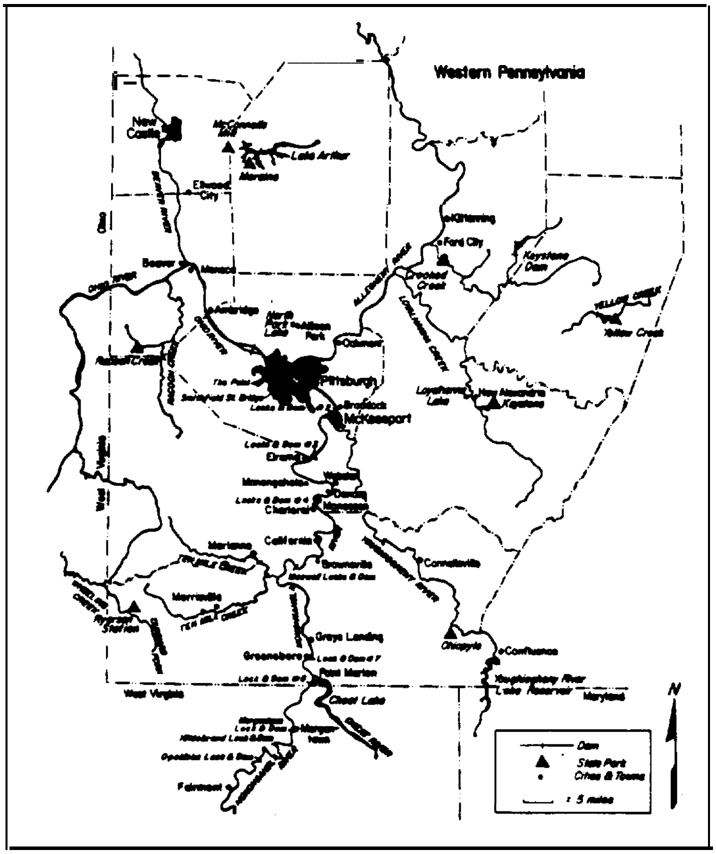

Figure 3-1. Map of Monongahela River and other area recreation sites.

- Tygart River Reservoir--A facility operated by the U.S. Army Corps of Engineers to provide flood control, recreation, and low flow augmentation. This reservoir provides most of the Monongahela's augmented flow, a minimum of 340 cfs in the upper river.

- Youghiogheny River Reservoir--A facility operated by the U.S. Army Corps of Engineers to provide a minimum flow of 200 cfs for the Monongahela River.

Comprising nearly 30 percent of the river basin's seven-county area, the following urban areas and boroughs (listed below with 1970 census population) line the Monongahela's banks:

Pittsburgh	520,117	Donora	8,825
McKeesport	37,977	Charleroi	6,723
Clairten	15,051	Brownsville	4,856
Duquesne	11,410	Braddock	8,795
Monessen	17,216	Glassport	7,450
Monongahela	7,113	Munhall	16,574
Morgantown	29,431	Port Vue	5,862
Fairmont	26,093	West Miff in	28,070

3.2.2 Uses

As part of the Mississippi River Waterway System, the Monongahela has a 9-foot-deep navigation channel from Pittsburgh to Fairmont to support both commercial and recreation river traffic. This navigation channel ranges in width from a minimum of 250 feet to nearly full river width at the river's mouth and is currently maintained by a series of nine lock and dam structures. The heaviest barge traffic occurs at Structures 2 and 3. Use of the locks and dams for generating hydroelectric power is currently under consideration and would provide an estimated total capacity of 96.2 megawatts. To support river traffic, the Monongahela's banks have a boat dock concentration approaching one dock per mile. However, these docks--which numbered 147 in 1979--are mostly single-purpose, single-user facilities.

Industrial activity along the Monongahela is dominated by the primary metals industry, which accounts for over 31 percent of the area's total manufacturing employment, including 29 percent of all Pennsylvania's steel industry employment. Also important with respect to industrial activity along the Monongahela are significant amounts of natural resources, including oil and gas, limestone, sandstone, sand and gravel, and coal. Area coal reserves are estimated at approximately 23 billion tons, and the Monongahela River region alone accounted for 24 percent of total 1977 coal production in Pennsylvania and West Virginia. Underground mining in the area produced 78 percent of this total, with strip mining operations accounting for the remainder.

3.2.3 Recreation

Because it essentially is a series of large pools--ranging from 400 to 1,741 surface acres--created by its nine lock and dam structures, the Monongahela offers substantial opportunities for recreation. In fact, although the lower 20 river miles, subjected to heavy industrial and urban development, offer limited recreation opportunities, the remaining 108 miles have seen dramatic increases in recreation usage over the last 10 years, partially because of improved water quality. As a result of this increased recreation usage, numerous public and private facilities have been developed along the Monongahela, ranging from single-lane boat launching ramps to boat club docks, commercial marinas, and community parks.

The primary recreation activities along the river are power boating and fishing. Because power boating is more popular, many recreation facilities have been constructed primarily to serve it. Partially as a result, the Monongahela River comprises a substantial portion of the water acreage available in the region for unlimited horsepower boating.

Although it is second to power boating in popularity, fishing occurs over a greater number of water acres in the area when small lakes and streams are considered. In fact, fishing accounts for approximately 12 percent of all current uses of the Monongahela. Fishing in the river is encouraged by special programs in both Pennsylvania and West Virginia to stock warmwater fish, and fish sampling has revealed the presence of up to 47 separate species, plus 3 hybrids. Of special interest, the U.S. Environmental Protection Agency (EPA) and the Pennsylvania Fish Commission, which have monitored fish population trends in the Monongahela since 1967, have reported a dramatic increase over an li-year period in species' diversity and biomass, particularly in the upper reach.

In addition to power boating and fishing, the Monongahela also offers other recreation opportunities at several major facilities, including two con-

pools; the Tenmile Creek Recreational Area (adjacent to the Maxwell Pool), which showed increased visitor days from 1972 to 1975; and the Prikett Bay Recreational Area (at Opekiska Pool), which has also experienced increased visitation from 1972 to 1975. Recreation activities offered by these sites include picnicking, camping, boating, and swimming. Despite its length and general popularity for recreation, the Monongahela nowhere offers either campgrounds or State parks for potential recreationalists, who are forced to the substitute sites offered by the Youghiogheny River Reservoir and the Allegheny River. Both of these substitutes offer better water quality than the Monongahela and, perhaps, more scenic settings for recreation.

3.2.4 Socioeconomic Profile

In 1977, population for the seven-county area of the Monongahela River basin totaled 2,417,885, which results in an average population density of 518 persons per square mile. Although density is greatest along the river, there is a recent trend to move into other areas. However, population changes in the basin vary according to State: several Pennsylvania counties have experienced a noticeable population decrease in the period from 1960 to 1977, but Monongalia County in West Virginia experienced a dramatic population increase during the same period. In general, the basin has a greater percentage of urban population than either the Pennsylvania or West Virginia State averages.

Per capita income within the basin is lower than either the Pennsylvania or West Virginia State averages, and the basin in fact contains a higher percentage of persons living below the poverty level than does either State generally. Not surprisingly, then, much of the basin's housing stock is generally Considered substandard, and, in 1970, 70 percent of it was more than 25 years old.

The average education level, which has steadily increased since 1950, is higher in the basin than it is in either Pennsylvania or West Virginia or in the United States generally. However, the difference between the basin and the nation has almost disappeared, eroded by a steadily rising U.S. education level. Another steadily eroding difference between the basin and the nation as a whole is in the percentage of the workforce made up of craftsmen and laborers. Specifically, due primarily to the area's heavy concentration of primary metals and extraction industry, the basin still has a higher concentration of blue collar workers than does the nation generally, but this difference has greatly diminished during the last 20 years.

3.3 SAMPLING PLAN

The following subsections describe the sampling plan implemented to accomplish the objectives of this study. A single-stage, area household sampling design was used to contact approximately 384 sample households in a four-county area of southwest Pennsylvania. Appendix A contains additional details of the survey design, sample selection, and weight calculation.

3.3.1 Target Population

Five counties comprised the sample area for this study (outlined in Figure 3-2): Allegeny, Fayette, Greene, Washington, and Westmoreland. These counties were selected because they contain the reach of the Monongahela River within Pennsylvania. The random nature of the sample resulted in no sample segments being chosen in Greene County. The target population consisted of all households in this five-county area. Group quarters were not included, and only adult (persons 18 years and older) household members were eligible for interview. One adult was selected for the interview from each household.

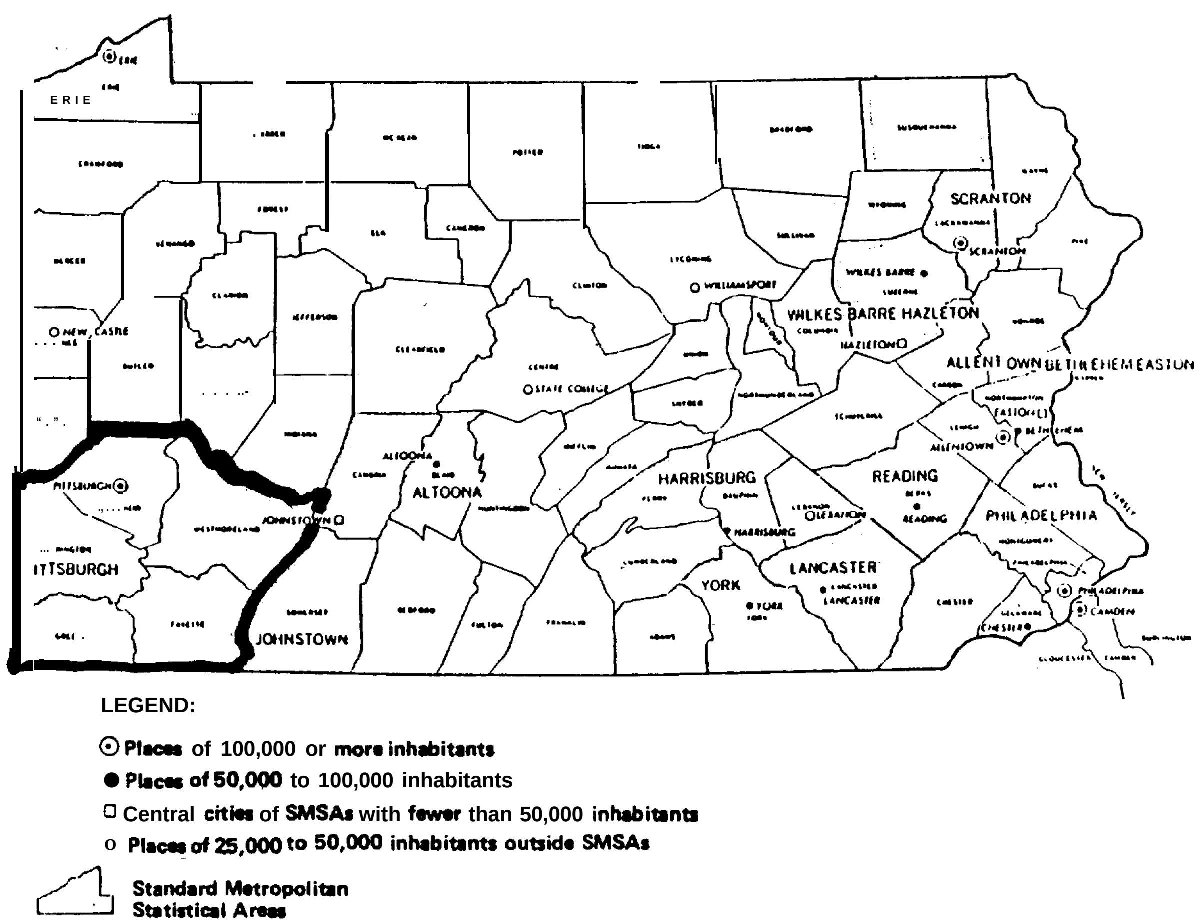

Figure 3-2. Geographic location of survey area.

3.3.2 Sample Selection and Survey Design

The design was a single-stage, stratified cluster sample. The sampling units (S US) were noncompact clusters of approximately seven households each. The clusters were developed by partitioning all the block groups (BGs) and enumeration districts (EDs) within the five-county area into non-compact clusters. The clusters were nonoverlapping and, when aggregated, completely accounted for all of the households in the five-county area.

The sampling units were stratified into three disjoint groups: (1) Pittsburgh, (2) not in a place, and (3) a place other than Pittsburgh. Fifty-one clusters with an average of 7.78 sample housing units (SHUs) each were selected, yielding 397 SHUS. A roster of all adults was compiled for each SHU. One adult was randomly selected from each SHU for interview.

3.3.3 Sampling Weights

The probability structure used to select the SHUS and the adults within each SHU allows calculation of the selection probability for each individual interviewed. The sampling weights, reciprocals of the probability of selection, were then calculated. Because interviews were not obtained from all selected SHUS (80.59 percent response), the sampling weights were adjusted for the nonresponse.

3.4 SURVEY PLAN

This project required a detailed survey plan to enable the successful completion of a full range of survey tasks. The following subsections discuss the '-procedures and methods developed to carry out these tasks. The major field tasks were as follows:

- To design and perform a limited local pretest of the survey questionnaire.
- To retain field interviewers.
- To count and list households within the randomly selected area segments. (Two field supervisors and two interviewers performed this task.)
- To develop a field procedures manual and interviewer training materials.
- To conduct a field interviewer training session.
- To administer the benefits instrument at randomly selected --households within the area segments. (One questionnaire was to be administered by an in-person interview at each sample household. The desired number of interviews to be conducted was 305.)

- To develop and implement onsite and off site quality control procedures on the work performed by the field staff.

- To conduct an interviewer debriefing.

- To develop and implement data receipt, data editing, and keypunch procedures for all resultant data.

3.4.1 Questionnaire Design and Limited Local Pretest

The design of the benefits questionnaire involved the combined talents of RTI staff knowledgeable in benefits analysis and questionnaire design, the EPA project officer, and selected consultants. Efforts to design the questionnaire centered on satisfying the two primary objectives:

- To collect the data required for analysis

- To collect the data in such a way that reliability and validity are enhanced.

In meeting these objectives, the number and types of questions included in the instrument and the format that those questions took were determined by several interrelated factors: Those factors included:

- The precise analytic goals of the survey.

- The adequacy of the project budget to support the data collection required.

- The facility of the interviewers in administering the instrument.

- The tolerance of potential respondents of the time and effort required to answer the questions.

- The ability of respondents to provide the data requested.

Table 3-1 outlines questionnaire development activity. After the data collection was completed and the interviewers debriefed, it was clear that the careful attention given to questionnaire design had reaped substantial rewards. The nuances of the questions and intricate skip patterns made necessary by anticipated responses necessitated a considerable investment of time early in the questionnaire development.

Another factor that had a considerable effect on the overall quality of the instrument was the variety of skills brought to bear on the wording of questions. The economic concepts, of course, resided with the economists. However, the wording of questions was critiqued by survey specialists for sensibility and administrative ease and further reviewed by staff experienced in questionnaire formatting and overall survey methodology. The net effect of these efforts was a questionnaire that was more comprehensible than the economists could have ever produced themselves and more sophisticated than the survey specialists alone would have designed.

Table 3-1. Questionnaire Development Activity

Activity	Date (1982)
Review existing survey work: Resources for the Future, Inc. (RFF) (Mitchell); Colorado State; Wyoming	August 5
Develop first draft for presentation at workshop	August 10
Revise draft for review by EPA project officer, consultant, and survey specialist	August 17
Incorporate revisions from review	August 20
Review by survey staff	August 22
Send revisions to EPA project officer for review by EPA survey liaison officer	August 24
Perform limited pretest in Raleigh area	August 26
Revise instrument based on pretest	August 28
Submit draft instrument to EPA for review	September 2
Revise instrument based on additional pretest	September 6
Submit Office of Management and Budget (OMB) package	October 9
Incorporate OMB suggestions	October 27
OMB approval	November 5

After the instrument was developed, it was administered on a limited pretest basis in the Research Triangle Park, North Carolina, area. Further limited pretesting of the instrument was completed in Pittsburgh after the Office of Management and Budget (OMB) package was submitted for EPA review.

The Research Triangle Park pretest was conducted on people from the Pittsburgh area to detect major faux pas in the instrument that Triangle-area residents could not perceive. As a result of this pretest, several recreation sites were added to the site list, the groups of activities were rearranged, and a better map was developed. Most of the benefits from the pretest came from dinding flaws in the logic of the questionnaire. The pretest was especially helpful in determining what subsequent questions were appropriate for zero bidders and for bidders who gave a zero to only certain parts of the questionnaire.

A limited budget prevented extensive pretesting in the target area. In future surveys this activity should be budgeted. Because of the logical consistency desired across all items in the questionnaire, a pretest in the survey area would reveal potential logical inconsistencies only sample area residents could expose via their responses. Researching the river and the sample area was a viable substitute; but a pretest in Pittsburgh would have been a valuable complement.

3.4.2 Retaining Field Supervisors and Hiring Interviewers

The project used two field supervisors experienced in hiring and training interviewers and in managing survey fieldwork to supervise and carry out the count-and-list task and to recruit the field interviewers who performed the household interviewing task. Because much of the cost of a data collection effort is due to count-and-list activities and to interviewer recruiting, using off site field supervisors made the project's field operations more economical. The survey task leader closely monitored the field supervisors in the count-and-list and recruiting activities, which were carried out during the week of October 19, 1981.

Project staff and the field supervisors worked together to select the interviewers from among experienced applicants who had previously performed well on similar surveys. Top prospects in the Pittsburgh area were screened by telephone to verify general qualifications, availability, and interest. During the count-and-list activity, the field supervisors interviewed some of the best qualified applicants in person. Personal and work references were checked before final selections were made. Relevant selection criteria included interest in the objectives of the study, availability of dependable transportation, perceived ability to relate well to the sample population of interest, input from personal and work references, and interviewing skills (e.g. , ability to read questions clearly, to follow instructions, to use nondirectional probes, to record responses accurately and legibly, etc.).

The selected interviewers were nine professionals who had extensive experience in household surveys, focus groups, census work, and a variety of other interviewing activities. These interviewers performed admirably throughout the data collection process, overcoming inclement weather, a few irate refusals, and an approaching holiday season. This was done with a refreshing enthusiasm and reinforced the confidence of the project team members. The interviewers were aware of all the things that can possibly bias a respondent and were careful to follow the procedures outlined in the manual and covered in the training session. In summary, the importance of using experienced, professional interviewers cannot be overstated.

3.4.3 Counting and Listing of Sample Segments

Two field supervisors and two experienced interviewers conducted all counting and listing of sample segments. This task involved:

- Locating the segment
- Identifying segment boundaries

- Counting the housing units
- Listing all eligible housing units.

The count-and-list task was completed in 1 week and the materials returned for an in-house check and preparation of interviewer assignments. Appendix B shows samples of the results from the count-and-list activities. Details of how these materials were used by the interviewers are provided in the Field Interviewer's Manual, available from Research Triangle Institute.

3.4.4 Developing Field Manuals and Conducting Interviewer Training

Because the interviewers were supervised from the Research Triangle Park during the household interviewing phase, a high degree of administrative organization of field personnel was required for the project. Interviewers were carefully informed of reporting and communications channels, procedures, schedule requirements, documentation of nonresponse, reassignments, quality control techniques, and other operating procedures required to complete the project in a timely, cost-effective manner. The Field Interviewer's Manual provided the details of the organization of the field procedures and covered the following topics:

- Purposes and sponsorship of the project
- Role of the interviewer
- Data collection schedule
- Field sampling and locating procedures
- Contacting and obtaining cooperation from sample members
- Reporting results of attempts to secure interviews
- Documentation of nonresponse
- Validations, field edits, and other quality control procedures
- Disposition of completed cases
- Completion of administrative forms (e.g. , field status reports, reassignment forms, and production and expense reports)
- Communications with central office staff.

In addition to the Field Interviewer's Manual, a series of administrative forms was -developed including a household control form (see Appendix B), which served the following functions:

- Provide assignment information for the interviewer (i. e. , sample household address).

- Provide the interviewer with an introductory statement explaining the survey.

- Provide appropriate household enumeration questions and queries to obtain demographic data on persons in the sample household.

- Provide the interviewer with instructions for selecting a household member to be interviewed.

- Require the interviewer to document all attempted and successful contacts with the sample member.

- Provide an appropriate set of result codes for describing interim and final results for each case.

- Require the interviewer to record certain information required for validation of completed interviews and noninterviews.

The training materials developed for the project included background on benefits analysis and administrative procedures. The Interviewer's Manual and a copy of the questionnaire were sent to the interviewers prior to their classroom training. A specified amount of time was authorized for advance study, and interviewers were expected to read the manual and specifications prior to the training session.

3.4.5 Training Session

The extensive experience of the interviewers enabled the project team to focus on the unique aspects of the project and to highlight the technical details of the interviewing procedures. The agenda, shown in Figure 3-3, shows the variety of topics covered in the 2-day session on November 11 and 12, 1981.

In addition to covering the project objectives, the training session provided an opportunity for personal interaction with the interviewers. The session focused on benefits, EPA water policy, the water pollution basics, and mock interviews with all versions of the questionnaire. The mock interviews included zero bidders, recalcitrant and reluctant bidders, use of the payment card, and procedural problems that might be encountered. The interviewers were reminded not to provide supplemental information but to reread an item as many times as necessary. Each interviewer received a healthy dose of information on benefits methodology and the important policy implications of the project. The participation by the project officer in the training also conveyed the feeling that the interviewers were important to the successful completion of the survey.

3.4.6 Conducting Household Interviews

Face-to-face interviews were conducted between November 13 and December 20, 1981. Conducting the interviews involved a series of interrelated operations, which included taking steps to obtain the desired number

Field Intewiewer Training Sassion Agenda

Study for Estimating Recreation and Related Benefits of Water Quality

November 11, 1981		
9:00 a.m.	Introduction of RTI staff and field interviewers	Kirk Pate
9:10 a.m.	Review of training agenda	Kirk Pate
9:15 a.m.	Project administrative procedures	Kirk Pate
9:45 a.m.	Break/picture taking and IDs	
10:15 a.m.	Explanation of the Benefits Study	Bill Desvousges
11:00 a.m.	Overview of field interviewer responsibilities	Kirk Pate
11:15 a.m.	Locating sample housing units	Kirk Pate
12:00 a.m. - 1:00 p.m.	Lunch	
1:00 p.m.	Completing household control form and selecting sample individuals	Kirk Pate
1:30 p.m.	Questionnaire administration	Kirk Pate
2:30 p.m.	Demonstration interview	Kirk Pate/ Bill Desvousges
2:45 p.m.	Break	
3:00 p.m.	Mock interview-Version A	Group
5:00 p.m.	Adjourn	
November 12, 1981		
9:00 a.m.	Questions and answers/discussion of yesterday's session	Kirk Pate/ Bill Desvousges
9:30 a.m.	Water pollution: Dimensions of a problem	Bill Desvousges
10:00 a.m.	The Benefits Study	Dr. Ann Fisher
10:30 a.m.	Mock Interview-Version C	Group
12:00 a.m. - 1:00 p.m.	Lunch	
1:00 p.m.	Questions and answers Distribution of assignments	
2:00 p.m.	Adjourn	

Figure 3-3. Field interviewer training session agenda.

of interviews, instituting interviewer assignment and reporting procedures, making initial household contacts and obtaining cooperation, enumerating household members, and administering the instrument.

Initial assignments of cases to interviewers were made on the basis of each interviewer's location and characteristics. Generally, assignments were made on the basis of the interviewer's geographic proximity to the sample segments. That was, of course, a cost-effective practice and usually resulted in interviewers sharing some characteristics with the people to be interviewed.

Efforts were made to equalize interviewer workloads; however, individual assignments were made after careful consideration of factors related to the difficulty of the areas assigned to each. Based on an assumed equal distribution of cases per interviewer, the average number of cases initially assigned per interviewer for the 6-week data collection period was 40. Under Number of Cases Assigned, Figure 3-4 shows the final case load for each interviewer after adjustments in the field.

RTI Project 2222-2

FIELD DATA Collection WEEKLY STATUS REPORT

ESTIMATING BENEFITS OF WATER QUALITY

Week # 6 Dates Covered: 12 / 15 / 81 to 12 / 21 / 81 Date Report Prepared: 12 / 22 / 81

FI Name	Number of Cases Assigned	No Action Taken	Cases in Progress	Enumeration Final Status Code*						Interview Final Status Code**					
				02	04	05	06	07	08	20	22	23	24	25	26
	42	0	42	1	3		4			29		3	1		1
	19	0	39	3	1					28		2	4		1
	57	0	57		6		4	2	1	40		1	3		
	36	0	36	1	1		2			31			1		
	64	0	64		1		1		1	54	1	1	3	1	1
	48	0	48	1			6			34	1	4	2		
	41	0	41	1	3					33		1	3		
	6	0	6							5			1		
	44	0	44	1				1		36		1	5		
	20	0	20	1	2		1		1	13		1	1		
TOTAL	397	0	197	9	17		18	3	3	303	2	14	24	1	3

*Status Codes:

02 No Enumeration Eligible Home
04 Enumeration Refused
05 Language Barrier
06 Vacant SHU
07 Not in SHU
08 Other

**Status Codes:

20 Completed Interview
22 Interview Breakoff
23 Not at Home/No Contact
24 Refused
25 Language Barrier
26 Other

Distribution List:

B. Desvousges
K. Pate
D. Smith
SOC Dept. 2 Files (22222)

Figure 3-4. Summary of completed interviews.

Once interviewer assignments were identified, interviewers' names were associated with each household control form. Thus, manual control of assignments was established and maintained. This control of assignments was updated weekly on the basis of status reports and receipt of completed work.

Once assignments were issued at the conclusion of training, rigid reporting procedures were implemented. At a specified time each week, each interviewer telephoned the survey specialist and reported the status of each assigned case, using the current status code from his copy of the household control form. The staff member entered the codes on a field status form for the reporting period and discussed each active case showing no progress or indicating a problem.

3.4.7 Initial Contacts and Obtaining Cooperation

Obtaining cooperation depended upon the persuasiveness of interviewers, who, as a result of training and experience, were able to communicate to respondents their own convictions regarding the importance of the study. There was no major problem in obtaining respondent cooperation. Interviewers indicated that people who were uncooperative for this project were no different from other survey experiences in the Pittsburgh area.

3.4.8 Household Enumeration

Once the interviewer made contact with an eligible household member, he proceeded to enumerate all individuals residing in the household. This procedure ensured that each age-eligible individual was given a chance to be selected for interviewing. All reasonable field efforts were made to interview all sample individuals. The following situations were anticipated and were handled as indicated below:

- Field efforts were discontinued once it was determined that a sample member had moved outside the sample counties.

- Field efforts were discontinued upon learning that sample members were deceased or institutionalized.

- When non-English-speaking respondents were encountered, an attempt to identify a close relative to serve as interpreter was made in an effort to complete the interview. There was only one interview with a language barrier, so no special effort was made in this area.

- An initial call and at least three additional callbacks were made at different times of the day and different days of the week in an attempt to establish contact with sample individuals to plete the interview.

- Contacts with neighbors were made after the second call to obtain "best time to call" information.

The enumeration process was facilited by the design of the household control form (see Appendix B), which contained procedural instructions, questions, and recording mechanisms to assist the nterviewer in identifying and listing household members and determining sample status. Procedures for assigning appropriate unique identifiers were also included.

3.4.9 Interviewing Procedures

Interviewers were instructed to attempt to conduct interviews immediately following the enumeration process when the sample member was identified and if he were available. If necessary, appointments were made to return at a time convenient for the sample member. All interviews were completed by means of a face-to-face interview. The average length of a completed interview was approximately 35 minutes.

Table 3-2 highlights the final tally from the field data collection. The final number of sample housing units was 397 due to the discovery by field interviewers of 13 housing units not listed during the listing phase of the

Table 3-2. Final Distribution of Sample Housing Units

Result category	Number	Percentage of SHUS
Out-of-Scope[a] SHUs.	21	
Vacant	18	4.53
Not an HU	3	.76
	21	5.29 (of 397 SHUs)
In-Scope[b] SHUS	376	
No enumeration eligible at home	9	2.39
Enumeration refused	17	4.52
Other enumeration result	3	.80
Completed interviews	303	80.59
Interview breakoff	2	.53
Sample individual not at home	14	3.72
Sample individual refused	24	6.38
Language barrier	1	.27
Other interview result	3	.80
	376	100.00

[a]Out-of-scope refers to sample housing units not included in response rate calculation.

[b]In-scope refers to sample housing units included in response rate calculation.

project. * The interviewers completed 303 interviews during the data collection period of November 13 through December 20, 1981 --two interviews short of the desired goal. The response rate (80.59 percent) was ever so slightly above the anticipated 80 percent rate, while the refusal rate equaled 10.90 percent.

*The count-and-list process is an imperfect one because interviewers are not required at that stage to actually knock on each door in an effort to identify housing units (HUS). Procedures for discovering HUs missed during the listing process are implemented during the household interviewing stage. The inclusion of each missed HU in the survey improves the statistical representativeness of the initial sampling frame.

Twenty-three sample households either did not complete the interview or refused to cooperate. These were 23 cases in which either no one was at home to provide the enumeration or the enumeration of the household members was obtained but the sample individual was never available to complete the interview. The crush of the Christmas holidays and a week of inclement weather conditions prevented resolution of these cases. Without either of these hindrances, it is not unreasonable to expect that an additional 15 to 20 interviews could have been obtained by the interviewers.

3.4.10 Interviewer Debriefing

The project staff and the project officer conducted a 1-day debriefing session in mid-December. This session provided an opportunity for the interviewers to evaluate survey procedures and the questionnaire relative to their other interviewing experiences. The overall conclusion of the debriefing session was that the questionnaire was generally easy to administer and that there were few major problems.

The comments that follow represent general impressions and evaluations of the interviewers. There is no way to validate them, but they certainly provided valuable insight for the project staff. The debriefing session was highly valuable for project staff, both in terms of current project and ideas for handling problems in future efforts.

Training Materials

- More background on water pol ution and recreation would have been helpful.

- Background and policy setting provided “keys” for getting in doors. Interviewers simply found it easier to pique people’s interest because they understood the project objectives better.

- More explanation of the payment vehicle--how people are currently paying for water pollution in higher prices and taxes -- would have been helpful to the interviewers.

Interviewing Process--General Comments

- Count-and-list maps and materials worked well.

- Drinking water was a major concern of many people, especially the elderly. This was not addressed in our instrument because of the recreation focus.

- There were occasions in which a spouse intervened or critiqued the interview responses of the sample individuals. The interviewers felt, however, that the respondents gave responses that reflected the households’ views.

- Refusals were generally three types: busy, timid, or nasty. This was no different from other household surveys, according to interviewers.

- Thirty minutes was the ideal length both in terms of administration and getting critical cooperation of respondents.

<u>Evaluation of Specific Parts of Questionnaire</u>

- Section A, with activities listing and sites, worked very well. Easy to administer and established interest of many respondents--especially recreators.

- Section B introduction is still wordy, especially B-1 introduction. "Season" ticket needed after advance in introduction.

- B-2. needed a skip pattern for non recreators.

- Few problems with B-3 or B-4.

- There was some confusion in B-5 as to how to interpret zero response to this question. Does it mean no change or a complete reduction? This will require careful attention in analysis. There was also some confusion over how the water quality might be bad sometimes and not at other times.

- Few problems with B-6.

- There was some concern in B-7 whether the amount given was the total amount already given, a new amount independent of other amounts, or an amount in addition to those given earlier.

<u>Visual Aids</u>

- Map and water quality ladder worked well.

- Visual aid showing how (but not how much) people are currently paying was needed to aid less perceptive respondents.

- Rank order card design was effective. People had little trouble connecting levels and dollar amounts, but cards should have been larger for easier use.

- Numbers on scale in water quality ladder were too small for elderly respondents.

- There could have been several more sites on the site listing.

- A better visual aid is needed for "use--might use, " perhaps with color and/or larger print.

Questionnaires

- The direct question of willingness to pay without a payment card was the most difficult version to administer because people often seemed uncomfortable without some aid (consistent with Mitchell and Carson's [1981] finding). The payment card was the easiest to administer.

- The bidding games usually reached an amount quickly as respondents supplied amounts after seeing how the process worked. The $125 starting point for each level was high relative to many bids making this slightly embarrassing for the interviewers to administer. Reason for high amount was to test for bias due to starting points.

- Specific suggestions for revising the questionnaire are presented in Appendix D.

3.4.11 Data Receipt, Editing, and Keypunching

The last phase of the survey process required careful handling of the survey data, coding, editing, and keypunching. Appendix B provides the details of this process. In general, completed questionnaires were received from the interviewers on a flow basis during the data collection period. In-house editing was performed by the survey specialist for the purpose of detecting any irregularities. As necessary, irregularities were discussed with the appropriate interviewer.

The only major coding of responses that was required involved the occupation questions. The verbatim responses were coded into the occupation classes from the Bureau of the Census. * Household control form and questionnaire data were keypunched on cards and verified before analysis began.

*March 1971, publication from the Census of Population, U.S. Department of Commerce, Washington, D. C. 20233.

CHAPTER 4

CONTINGENT VALUATION DESIGN AND RESULTS: OPTION PRICE AND USER VALUES

4.1 INTRODUCTION

Application of the contingent valuation approach, also referred to as the direct survey approach in environmental economics, asks individuals their dollar valuation of a nonmarket "commodity" --i.e. , some good or service not traded in an actual market. * In environmental applications, the analyst must create a hypothetical market by describing how individuals would pay for specific improvements in environmental quality. For this benefits study of the Monongahela River basin, the contingent valuation design used a household survey to ask individuals' valuation in terms they could understand--terms that translate the water quality improvements into additional activities, such as swimming and recreation fishing, that individuals could undertake along the Monongahela River.

Contingent valuation offers the analyst considerable flexibility in designing the "commodity" to be valued in the hypothetical market. At the same time, however, it requires that he take considerable care in designing the market so it is both credible and understandable to the respondent. Indeed, research suggests that contingent valuation results may be sensitive to the question formats used to elicit an individual's valuation, the mechanism used to obtain the hypothetical payments (payment vehicle--e. g., user fee or utility bill increase), and the interviewers used to conduct the survey. To give useful results, the survey design must successfully surmount these influences.

The contingent valuation design for estimating the recreation and related benefits of improved water quality in the Monongahela River used research methods in fields ranging from survey and sample design to resource economics. This chapter traces the origins of the design, describes the survey questionnaire, characterizes the survey respondents, and presents the results on option price and user value for the water quality improvements.

Section 4.2 reviews survey design issues, paying close attention to potential biases in contingent valuation research, and Section 4.3 describes major components of the survey questionnaire, including the design for determining

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*The interpretation of the valuation requested of respondents will depend upon the nature of the question. For example, whether a willingness-to-pay or willingness-to-sell measure is elicited wiil depend on the property rights and nature of the change proposed in the question.

differences in techniques to elicit option price responses, the selection of a payment vehicle, and the design of tests for achieving plausible results. Section 4.4 characterizes the survey respondents and the main groups of interest among them (users and nonusers of the river and people who refused to pay any amount for improved water quality), Section 4.5 describes the estimated values for option price and the statistical analyses of these estimates, and Section 4.6 provides the same information for user values. Section 4.7 summarizes the chapter's main findings.

4,2 A REVIEW OF DESIGN ISSUES IN CONTINGENT VALUATION SURVEYS

In constructing a hypothetical market, the contingent valuation approach defines the commodity to be valued, specifies how the exchange would occur, and describes the other structural elements of the market. Brookshire, Cummings, et al. [1982] have labeled this process as "framing the question, " or as simply setting the context presented to respondents as part of the contingent valuation experiment. As with almost any type of experimental design, the context can influence the outcome. For example, within the range of different contingent valuation contexts , an individual might participate directly in a bidding procedure to elicit willingness to pay for the hypothetical commodity, might directly reveal this value (with or without the aid of some type of payment card), or simply might evaluate (rank) various outcomes of the hypothetical market, as in the case of the contingent ranking format.

Partially because of this range of contexts, the various attempts to classify the methods for implementing the contingent valuation approach--and their design features -- have created considerable confusion. Therefore, to consider the context of the contingent valuation approach used for the Monongahela River basin, this section is organized according to the approach's potential biases. These biases are not neatly compartmentalized; rather, they are overlapping and in some cases interrelated. (Indeed, one analyst's strategic bias is another's hypothetical bias.) At the risk of blurring the boundaries between compartments, the section notes the most important of these interrelationships. The boundaries themselves may, in large part, be a question of judgment.

4.2.1 Hypothetical Bias

Hypothetical bias in contingent valuation surveys is the bias attributable to the use of a hypothetical, not an actual, market situation, and it arises when individuals cannot or will not consider the questions in a manner that corresponds to how they would treat the actual situation. Consequently, we can expect that they provide inaccurate answers to the contingent valuation questions about it. Mitchell and Carson [1981] argue that hypothetical bias may increase respondents' uncertainty and ambivalence about the hypothetical experiment or induce them to provide answers that they perceive are socially desirable. In general, hypothetical bias may result in respondents rejecting or refusing to participate in the contingent valuation experiment, but the net effect is to increase the statistical variance and to lessen the reliability of the estimated willingness-to-pay amounts.

The empirical evidence on hypothetical bias is somewhat mixed, with some studies hindered by it and others showing no evidence. To test for several biases, Bohm [1971] designed an experiment that compared alternative bidding and payment schemes for the valuation of public television. Several alternatives were provided to respondents, and, in some cases, the respondents were actually given money to spend on several alternatives to public television. Bohm compared results from the group that answered hypothetical willingness-to-pay questions with those from a group that actually had to pay for public television. The willingness-to-pay bids from respondents who had to pay for public television were less, and significantly different, than those from respondents who were simply asked how much they were willing to pay. These results imply that hypothetical and strategic behavior were present in the contingent valuation approach.

Mitchell and Carson [1981] question Bohm's [1971] conclusion on hypothetical bias based on a reinterpretation of his statistical evidence. Bohm's results showed that only one group out of six had different mean values when structured across different types of information and market actuality. The group that did exhibit higher willingness-to-pay amounts was also the group that had higher incomes, which, Mitchell and Carson argue, may account for the size of its mean willingness-to-pay bid. This same group also had one outlier that raised the mean bid considerably. If the outlier is removed, the mean payment is reduced to a level at which it is no longer a statistically significant difference in the means.

Bishop and Heberlein [1979] designed a mail survey that compared hypothetical willingness-to-pay amounts and actual willingness to sell. In this study respondents were mailed checks in randomly selected amounts and requested to sell a hunting license they had previously purchased. The authors found that the amounts the respondents were willing to accept for their hunting licenses when presented with an actual check were considerably less than the willingness-to-pay amounts they gave in the hypothetical bidding game portion of the experiment. However, the results of the hypothetical and simulated market experiment suggested that the hypothetical market underestimated willingness to pay relative to the actual estimates from the simulated market. The Bishop- Heberlein findings suggest hypothetical bias may be a significant problem in contingent valuation survey design, but the implications of their research may be limited by their experimental design.

Significantly, the results of several studies have indicated that hypothetical bias may contribute to the considerable variability in contingent valuation estimates of willingness to pay. For example, the Brookshire, Ives, and Schulze [1976] and Brookshire et al. [1979] air quality studies explain less than 10 percent of their bid variation by either socioeconomic variables or changes in the level of the environmental good that the survey was designed to measure.

While not--invalidating the approach as a means of measuring consumers' willingness to pay, the potential for hypothetical bias in contingent valuation surveys indicates the need for considerable attention in the instrument design phase to provide a credible survey questionnaire. The respondent must be able to perceive the experiment as a realistic approach to measuring the good under consideration. Aizen and Fishbien [1977] have shown that the more closely a hypothetical experiment corresponds with actual situations, the greater the chance of reducing hypothetical bias. Mitchell and Carson [19811 argue that reducing hypothetical bias in a contingent valuation survey instrument does not necessarily lead to increased probability of incurring strategic bias (where a respondent attempts to influence results) or other types of biases. Rather, they suggest that a hypothetical experiment in which the market realism is high and consequence realism is low will reduce or minimize each type of bias. That is, respondents will perceive that a hypothetical situation closely corresponds to a real market situation (high market realism), but they will not perceive the nature of the consequences of the hypothetical experiment (to themselves) to the extent that they will attempt to influence the outcome (low consequence realism).

The Mitchell and Carson position differs considerably from that of Schulze et al. [1981], who argue that the potential for strategic bias increases when hypothetical bias is reduced. Mitchell and Carson present a viable alternative to the Schulze position in showing that both biases can be overcome in survey design. Specifically, Mitchell and Carson were able to explain a considerably larger percentage of the variation in willingness to pay than could authors of most earlier contingent valuation studies and did not find evidence of strategic behavior on the part of respondents. Furthermore, the Mitchell and Carson results are particularly encouraging because their hypothetical market design offered national water quality as a product, an unconventional situation that should be particularly sensitive to hypothetical bias.

4.2.2 Strategic Bias

The concern for strategic bias is usually attributed to Samuel son [1954], who suggested that any attempt to value public goods will be plagued by incentives on the part of individuals or respondents to behave strategically. Samuel son argued that, if individuals perceive they will be able to obtain a public good and enjoy its consumption, they may indeed try to obtain this public good by not revealing their true preferences. The thrust of the Samuel son argument for questionnaire design is that, depending on how respondents perceive the consequences of the hypothetical experiment, they may behave strategically. For example, an environmentalist who thinks his bid might affect some environmental policy may bid higher than his true willingness to pay in order to increase the average bid, provided he knows he will not have to pay based on these bids. Alternatively, if an individual believes his payment will be based on responses given to the questions, there will be incentives to conceal true preferences provided the individual is reasonably sure the good will be provided.

The empirical evidence on strategic behavior in contingent valuation surveys has generally found that strategic behavior is not a major problem for interpreting willingness-to-pay amounts. For example, Brookshire, Ives, and Schulze [1976] and Rowe, d'Arge, and Brookshire [1980] attempted to design experiments that would indicate the existence of strategic bias. In these experiments, respondents were asked to reveal their willingness to pay for changes in a public good, which, if provided, would in turn require them to pay their share of the mean of all bids. Brookshire et al. [1979] show that, for respondents to engage in strategic behavior in the type of situation used in the Brookshire and the Rowe, d'Arge, and Brookshire studies, they would have to know not only the amounts that other individuals had bid, but also the number of bidders who had already been asked and their mean bid. Both studies concluded that strategic bias was not evident in the sample data generated when respondents were told they would have to pay the mean of the sample. The Brookshire test for strategic bias examined the distribution of the bids, arguing that strategic bias leads to a bimodal distribution in which the means for environmentalists are concentrated in the high values of the distribution while the means for nonenvironmentalists fall primarily at the other extreme. The Rowe, d'Arge, and Brookshire test involved a more rigorous statistical analysis but found no support for strategic bias after problem bids were eliminated. This study also provided one group of respondents with information on the sample mean bid after it had made its bid and allowed it to change on the basis of this new information. The authors found that only one respondent desired to change an overall bid. The complexity of the survey questionnaire used in the Rowe study, as well as the methods used to screen observations omitting some bids from the sample, limits the generality of the study results. A study by Brookshire, Ives, and Schulze [1976] also found no evidence of strategic bias in an examination of the distribution of willingness-to-pay amounts.

Mitchell and Carson [1981] argue that the distribution test used to indicate strategic bias in these earlier studies is inappropriate because it is impossible for most willingness-to-pay distributions to have standard normal distributions. They argue that the likely distribution is a lognormal one, as shown in their empirical results. Unfortunately, there are two problems with the Mitchell and Carson results on strategic bias. First, their sample was subsegmented into groups by income levels, which could have influenced the hypothesized relationship between willingness to pay and income. Second, Mitchell and Carson's results were limited by a substantial number of zero bidders and protest bidders who, given the limitations of the experimental design, prevented them from eliciting additional information on true preferences.

A forthcoming report by Cronin [1982] on willingness to pay for improved water quality in the Potomac River suggests the existence of strategic bias. The design of this study partitioned respondents into groups based on whether they would actually have to pay their bid through increased local taxes based on the mean bid or would have to pay very little because the Federal government would pay for most of it. A comparison across the two groups showed statistically significant differences in the mean willingness-to-pay amounts that are consistent with the presence of strategic bias. 'Some caution is needed in interpreting the Cronin finding because of a poorly designed survey questionnaire and specification problems in the willingness-to-pay equation.

Based on the evidence that currently exists, strategic bias s not the pervasive problem that researchers originally feared. However, it may be a problem if the questionnaire design does not provide a low-degree-of-consequence realism. Mitchell and Carson [1981] conclude that effectively designed survey questionnaires can achieve the required degree of realism.

4.2.3 Payment Vehicle Bias

Payment vehicle bias occurs when a respondent is influenced by the method of payment selected for the contingent valuation study. A number of different payment methods comprise the range of payment vehicles: user fees, increases in utility bills, and higher consumer prices and taxes. To be effective, a payment vehicle must be realistic and familiar to respondents so they consider it plausible and realize the implications of the implied payment frequency for their total willingness to pay in a given time period. The ideal payment vehicle would combine believability with a wide range of alternative payment amounts.

The contingent valuation literature indicates very little about the influence of payment vehicle bias. In the only study that systematically examined this bias, Rowe, d'Arge, and Brookshire [1980] found that the type of payment vehicle--utility bill or payroll deduction -- had a significant effect on willingness to pay. One-l ikely consequence of a particular payment vehicle is that it may condition respondents to a range of values their responses are expected to take. For instance, when a user fee is selected as the payment vehicle, it is quite possible that the respondent will think in terms of a usual range for user fees. Thus, payment vehicle bias may actually show up as starting point bias, discussed below. On the other hand, general resentment of taxes could lead to "pure" payment vehicle bias, in which the respondent rejects the payment vehicle itself.

4.2.4 Starting Point Bias

The contingent valuation literature has devoted more attention to the question of starting point bias--the influence of the starting points used in iterative bidding (or any contingent valuation procedure that uses starting point " keys, " such as the Mitchell-Carson [1981] payment card) --than it has to the other biases. In an evaluation of willingness to pay for air quality in the Farmington, New Mexico, area, for example, Rowe, d'Arge, and Brookshire [1980] found strong evidence of the effects of starting points, with a respondent's bid for improvements in visibility increasing by $0.60 for every $1.00 increase in the starting point.

Brookshire et al. [1979] also found starting point bias in some of their alternative bidding situations. However, their starting point bias tests are difficult to interpret because their study had very small sample sizes across the alternative starting points, ranging from 2 to 16 respondents. Combined with the substantial standard deviation for the mean responses, these small sample sizes make it difficult to reject the null hypothesis that starting point has no effect. Mitchell and Carson [1981] argue that the small sample size may have had a greater impact on the study's inability to detect starting point bias in the Brookshire et al. [1979] study than the researchers realized. In addition, Mitchell and Carson [unpublished 1982] have also suggested that the Greenley, Walsh, and Young [1981] study was also hindered by starting point bias. The payment vehicles chosen by Greenley, Walsh, and Young inadvertently set two different starting points for the bidding process.

Several other studies--including those by Brookshire and Randall [1978], Thayer and Schulze [1977], Randall et al. [1978], and Thayer [1981]--have also tested for starting Point bias in various degrees. These studies found no evidence of influence on willingness to pay that could be attributed to different starting points. Unfortunately, the research design of some of these studies was inadequate to sufficiently test for starting point bias. The Randall study was not aple to differentiate mean bids by starting points, and several of the other studies tested starting points whose relative amounts were too close to provide conclusive results.

In summary, the literature on starting point bias indicates that, when a bidding game is used to elicit willingness to pay, the results can be influenced by the starting point used in the bidding process, suggesting that tests for starting Point bias should be included in the research design. The Thayer [1981] study provides both a simple test for the existence of starting point bias and an adjustment for willingness-to-pay bids if starting point bias exists. However, the assumptions implicit in Thayer's test may limit its practical application, since it assumes the respondent has a nonstochastic honest bid.

4.2.5 Information Bias

Information bias is the influence on an individual's valuation that is attributable to the amount of information given to respondents in the survey questionnaire. The literature provides very little evidence on the extent of information bias. Careful questionnaire design and thorough interviewer training to provide consistent and equal information to each respondent should minimize this bias. *

4.2.6 Interviewer Bias

Interviewer bias is attributable to the effect of using different interviewers to elicit individuals' valuations. This bias can stem from one interviewer being more effective than another, either in administering a bidding game or in establishing rapport with the respondent. In his seminal research on wilderness experiments in the Maine woods, Davis [1963] established a high level of rapport with the respondents but performed all of the interviews himself. A recent study by Cronin [1982] was able to test for the existence of interviewer bias and indicates that willingness to pay can be influenced by the interviewer. But the design of the test was not sufficiently robust for a conclusive result. The prospects for interviewer bias can be minimized with training sessions and by using experienced professional interviewers. Nonetheless, even when training is used, the research should examine the influence of using different interviewers because this may serve to identify other influences on the bids that were not previously recognized.

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*This is an example of a bias category that is not easily distinguished from the problems associated with "framing" the experiment.

Table 4-1. Summary of Biases in Contingent Valuation Experiments

Type of bias	Definition	Studies that have tested for bias	Summary of current results[a]
General			
Hypothetical	Error introduced by posing hypothetical conditions rather than actual conditions to an individual; response may not be a good guide to actual actions individual would take	One known test--Bishop-Heberlein [1979], Bohm [1971]	Some indication that hypothetical nature of question did influence responses, but could not distinguish this effect from instrument-related biases
Strategic	Attempt by respondents to influence outcome of study by systematically over- or under-bidding so action favors their true interests; strategic responses depend on how payment scheme is defined and whether it is 'believed	At least eight tests (see Schulze, d'Arge, and Brookshire [1981] for summary; Cronin [1982])	Very little evidence of strategic bias except for Cronin [1982]
Instrument related			
Starting point	Contingent valuation experiments using bidding game format have started with suggested payment and use yes or no responses to derive final willingness to pay; suggestion may be perceived as appropriate bid	At least five tests (see Schulze, d'Arge, and Brookshire [1981] and Rowe and Chestnut [1981])	Some differences in opinion over importance of starting point bias; Mitchell-Carson [1981] feel starting point bias is important, and Desvousges, Smith, and McGivney [1982] provide some support; Schulze, d'Arge, and Brookshire [1981] feel it is more limited
Vehicle	Characteristics of proposed mechanism for obtaining respondent's willingness to pay may influence responses	At least four tests (see Schulze, d'Arge, and Brookshire [1981] and Mitchell and Carson [1981])	Some evidence of effects in at least two studies
Information	Effect of information provided to respondent on costs of action under study or other dimensions of problem may affect responses	At least four tests (see Schulze, d'Arge, and Brookshire [1981] and Mitchell and Carson [1981])	Limited evidence of effects
interviewer	Responses vary systematically according to interviewer	Two tests--Desvousges, Smith, and McGivney [1982] and Cronin [1982])	No evidence of bias Bias present

[a]The definitions and results summarized in this table are based on Schulze, d'Arge, and Brookshire [1981], Rowe and Chestnut [1981], and Mitchell and Carson [1981].

4.2.7 Summary and Implications for Contingent Valuation Research Design

Table 4-1 summarizes the relevant research on potential biases in contingent valuation studies discussed above. Based on this information, the Monogahela River contingent valuation study was designed to test for starting point bias. In addition, after the surveys were completed, the statistical analysis examined the prospects for interviewer bias. The structure of the survey attempted to control for information, vehicle, hypothetical and strategic biases in the survey questionnaire.

4.3 QUESTIONNAIRE DESIGN

questionnaire design is the most critical task in a contingent valuation study. This section describes the questionnaire used to estimate the recreation and related benefits of water quality improvements for the Monongahela River in Pennsylvania. Specifically, building on the sampling plan and survey procedures discussion in Chapter 3 and on the contingent valuation survey biases discussion in Section 4.2, this section explains the treatment of potential biases either as an element in the questionnaire design or as an objective in the analysis of the resulting data.

4.3.1 Questionnaire Design: Part A

A key ingredient in successful contingent valuation surveys is establishing credibility for the survey objectives (see Appendix D for a complete copy of the questionnaire). The first component of the questionnaire has to achieve this objective without biasing or offending the respondent. Part A in the Monongahela River questionnaire attempted to achieve these goals by inquiring about recreation activities the respondent had engaged in during the last year. The first two questions dealt with boat ownership to determine if the respondent had easy access to a boat for recreation purposes through either ownership or “borrowing” rights. Ditton and Goodale [1973] found boat ownership to be a significant factor in recreation attitudes and activities in Green Bay, Wisconsin. This suggested a question that was unlikely to offend any respondent.

Following the boat ownership question, the interviewer presented the list of outdoor recreation activities shown in Figure 4-1 and asked if the respondent had participated in any of the activities within the past 12 months. The list contains a wide range of activities, including those usually associated with water recreation --boating, fishing, and swimming--and those that occur near water- -picnicking, biking, and sightseeing. The list is a subset of the activities listed in the 1977 Federal Estate Survey data base used in estimating the travel cost model in Chapter 7. This activity matching was an attempt to provide additional compatibility between the methods.

A “no” answer to the participation question on the Monongahela questionnaire moved ‘the respondent into ‘the benefits section, while yes response initiated the site/activity matrix, illustrated in Figure 4-2. The interviewer used the site/activity matrix to record the sites visited, the number of visits, and the activities in which the respondent participated. The interviewer provided the respondent with two additional visual aids to facilitate this

	01	Canoeing, kayaking, or river mnning
	02	Other boating
On or In	03	Sailing
water	04	Water skiing
	05	Fishing
	05	Swimming outdoors or sunbathing
	07	Camping in a developed area
	08	Picnicking
	09	Walking to observe nature or bird watching; wildlife or bird photography
	10	Other walking for pleasure or jogging
	11	Bicycling
	12	Horseback riding
Near	13	Hunting
Water	14	Hiking or backpacking
	15	Attending outdoor sports avents (do not include professional football or baseball)
	16	Other outdoor sports or games
	17	Driving vehicles or motorcycle off-mad
	16	Driving for pleasure
	19	Sightseeing at historical sitea or natural wonders

Figure 4-1. Activity card.

Site Names Not Listed	Site Codes	No. of Visits	CANOEING, KAYAKING, ETC.	OTHER BOATING	SAILING	WATER SKIING	FISHING	SWIMMING, SUNBATHING	CAMPING	PICNICKING	BIRD/WILDLIFE OBSERV/PHOTO	OTHER WALKING/JOGGING	BICYCLING	HORSEBACK RIDING	HUNT'NG	HIKING OR BACKPACKING	ATTEND SPORTS EVENTS	OTHER OUTDOOR SPORTS	OFF-ROAD DRIVING/RIDING	PLEASURE DRIVING	SIGHTSEEING
			01	02	03	**04**	05	06	07	08	09	10	11	**12**	13	**14**	Is	16	**17**	**18**	**19**
			01	02	03	**04**	05	06	07	08	09	10	**11**	12	**13**	**14**	15	16	17	**18**	19
			01	02	03	**04**	05	06	07	08	09	**10**	11	12	13	**14**	1s	16	**17**	18	**19**
			01	02	03	**04**	05	06	07	08	09	10	11	12	13	14	15	16	17	**18**	19
			01	02	03	**04**	05	06	07	08	09	10	**11**	12	13	**14**	15	16	17	1.9	19
			01	02	03	**04**	0s	06	07	08	09	10	11	**12**	13	**14**	**15**	16	17	**18**	**19**
			01	02	03	04	05	06	07	08	09	10	11	12	13	**14**	1s	16	17	**18**	19
			01	**02**	03	**04**	0s	06	07	08	09	10	**11**	12	13	**14**	15	16	**17**	**18**	19
			01	02	03	**04**	05	06	07	**08**	09	10	**11**	12	13	**14**	1s	16	17	18	19
			01	02	03	04	05	06	**07**	08	09	**10**	**11**	12	13	**14**	15	16	17	**18**	**19**
			01	02	03	**04**	0s	06	07	08	09	10	11	12	13	**14**	**15**	16	17	**18**	**19**
			01	02	03	04	0s	06	07	08	09	10	**11**	12	13	**14**	1s	**16**	17	**18**	19
			01	02	03	04	05	06	07	**08**	09	**10**	**11**	**12**	**13**	14	1s	16	**17**	**18**	19
			01	02	03	04	05	06	07	**08**	09	10	**11**	12	13	**14**	**15**	16	**17**	**18**	**19**
			01	02	03	04	05	06	07	**08**	09	10	**11**	12	**13**	**14**	**15**	16	**17**	**18**	**19**
			01	02	03	04	05	06	07	**08**	**09**	10	**11**	12	13	**14**	**15**	16	17	18	**19**

Figure 4-2. Site activity matrix.

discussion--a colored pictorial map of the area shown in Figure 4-3 and a list of recreation sites (also shown on the map) displayed in Figure 4-4. The respondent described the information requested for these sites or any other sites visited. The data collected in part A completed a recreation profile of the respondent that could be used in the analysis phase and established a rapport with him without influencing the main objective--benefit estimation. Part A also reinforced the idea that a wide range of recreation site services is influenced by water quality.

4.3.2 Benefits Measures: Part B

Part B of the Monongahela River questionnaire established the hypothetical market by describing Its institutional arrangements. In other words, this part described the hypothetical market, the commodity to be valued, the payment vehicle, and enacted the valuation experiment. The first section introduced the setting for the hypothetical market:

> The next group of questions is about the quality of water in the Monongahela River. Congress passed water pollution control laws in 1972 and in 1977 to improve the nation's water quality. The States of Pennsylvania and West Virginia have also been involved in water quality improvement programs of their own. These programs have resulted in cleaner rivers that are better places for fishing, boating, and other outdoor activities which people take part in near water. we all pay for these water quality improvement programs both as taxpayers and as consumers.
>
> In this study we are concerned with the water quality of only the Monongahela River. Keep in mind that people take part in all of the activities on Card 1 (Figure 4-1) both on and near the water.

Following the introduction, the interviewer handed the respondent the key visual aid for the hypothetical market--the Resources for the Future (RFF) water quality ladder developed by Mitchell and Vaughan at RFF and used by Mitchell and Carson [1981] in their contingent valuation study of national water quality (see Figure 4-5). Appendix E provides details on its construction. The ladder's major attribute is that it easily establishes linkages between recreation activities and water quality based on an index of technical water quality measures and informed judgment. This type of linkage illustrates a crucial distinction between the contingent valuation method and indirect techniques for measuring the benefits of water quality. Specifically, rather than observing the actual behavior of recreationalists, who demand different site services depending on the level of water quality, it directly introduces the relationship between activities and different water quality levels into the hypothetical market.

After showing the key visual aid, the interviewer read the following text* to describe the ladder and establish the desired linkages:

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*The words in all capitals are instructions for the interviewers only and were not read to the respondent. They are included in the discussion for completeness.

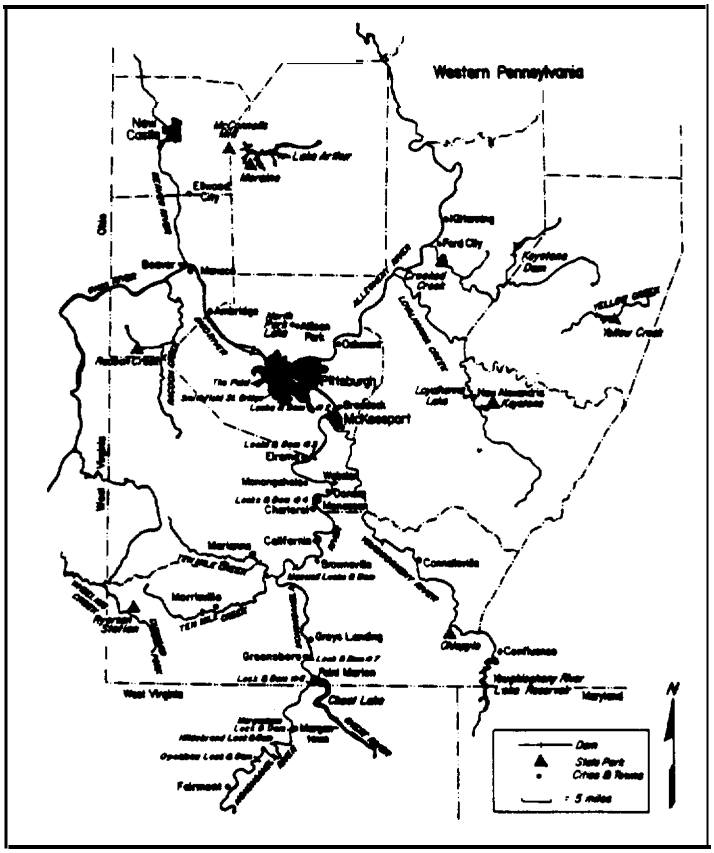

Figure 4-3. Map of Monongaheia River and other retreat ion sites.

Alegheny River:		Monongahela River Area:	
01	Near Kittanning	15	Pittsburgh (The Point, Smithfield Bridge, Braddock)
02	Near Oakmont	16	Where Monongahela and Youghiogheny meat near McKeesport
03	Where Beaver River and Ohio River meat	17	Elrama
04	Crookad Creak Park	18	The Town of Monongahela
05	Loyalhanna Lake	19	Donors and Webster
06	Keystone Dam	20	Near Charleroi (Lock and Dam #4)
07	Laka Arthur in Moraine State Park	21	In tha California-Brownsville Area
08	Ohiopyle Stata Park	22	Maxwell Lock and Dam
09	North Park Lake (Near Allison Park)	23	Ten Mile Creek
10	Racoon Creak State Park	24	Grays Landing–Greensboro (Lock and Dam #7)
11	Youghiogheny River Lake Reservoir	25	Point Marion-cheat River Area (Lock and Dam #B)
12	Cheat River Laka	26	Morgantown
13	Ryerson Station	27	Hildebrand
14	Yellow Creek	28	Opekiska
		29	Fairmont

Figure 4-4. Recreation sites.

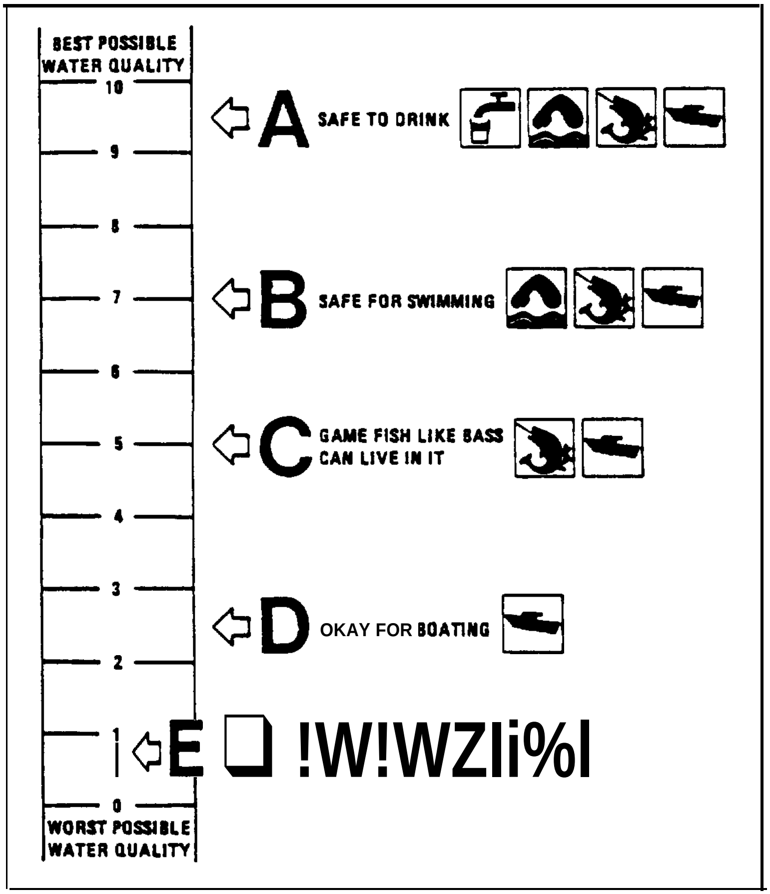

Figure 4-5. Water quality ladder,

Generally, the better the water quality, the better suited the water is for recreation activities and the more li kely people will take part in outdoor. recreation activities on or near the water. Here is a picture of a ladder that shows various levels of water quality. **GIVE RESPONDENT CARD 4,"WATER QUALITY LADDER."**

The top of the ladder stands for the <u>best</u> possible quality of water. The bottom of the ladder stands for the <u>worst</u> possible water quality. On the ladder you can see the different levels of the quality of the water. For example: (POINT TO EACH LEVEL--E, D, C, B, A--AS YOU READ THE STATEMENTS BELOW.)

Level E (POINTING) is so <u>polluted</u> that it has oil, raw sewage and other things like trash in it; it has no plant or animal life and smells bad.

Water at Level D is okay for boating but not fishing or swimming.

Level C shows where the water is clean enough so that gamefish like bass can live in it.

Level B shows where the water is clean enough so that people can swim in it safely.

And at Level A, the quality of the water is so good that it would be possible to drink directly from it if you wanted to.

Following this description, the interviewer asked the respondent to use the ladder to rate the water quality in the Monongahela River on a scale of O to 10 and to indicate whether the ranking was for a particular site, and, if so, to name it.

Question B-2 introduced the respondent to a key element in the hypothetical market: the distinction between user, option, and existence values. Specifically, the interviewer gave the respondent the value card shown in Figure 4-6 and described each type of value. An attitudinal question punctuated the descriptions of each type of value by inquiring how important the factors of actual use, potential use, and no use were in valuing water quality. The attitudinal responses to these question s--displayed on a five-point scale ranging from very important to not important at all --reinforced the concepts, provided a break in the discussion, and presented an additional check for the consistency in responses. The textual explanations for the three types of values are:

Why We Might Value Clean Water in the Monongahela River

I. Use

Swimming	Hiking
Fishing	Sitting by the shore
Boating	Hunting
Picnicking	Driving vehicles off road
Birdwatching	Jogging

II. Might Use

To have clean water in the river to use if you should decide in the future that you want to use it.

III. Just Because It's There

Preserve for future generations.

Satisfaction from knowing that there is a clean river.

Satisfaction from knowing that others can enjoy the river for recreation.

Figure 4-6. Value card.

Another important purpose Of this study is to learn how much the quality of water of the Monongahela River is worth to the people who live in the river basin. In answering this question, there are three ways of thinking about water quality that might influence your decision. GIVE RESPONDENT CARD 5, "VALUE CAR D." The three ways are shown on this card.

One, you might think about how much water quality is worth to you because You use the river for recreation. POINT TO PART I OF VALUE CARD AND GIVE RESPONDENT TIME TO READ THAT PART.

How important a factor is your actual use of the river in making a decision about how much clean water is worth to you? CIRCLE NuMBER.

VERY IMPORTANT. 01

SOMEWHAT IMPORTANT 02

NEITHER IMPORTANT NOR
UNIMPORTANT. 03

NOT VERY IMPORTANT 04

NOT IMPORTANT AT ALL 05

Another way you might think about how much clean water is worth to you is that it is worth something to you to know that a clean water river is being maintained for your use if you should decide, in the future, that you want to use it. POINT TO PART II OF VALUE CARD AND GIVE RESPONDENT TIME TO READ THAT PART. For example, you might buy an advance ticket for the Steelers or Pirates just to be able to go to a home game if you later decide you want to go. Likewise, you might pay some amount each year to have a clean water river available to use if you should decide to use it.

In deciding how much clean water is worth to you, how important a factor is knowing that a clean water river is being maintained for your use, if you should decide to use it? CIRCLE NUMBER.

VERY IMPORTANT. 01

SOMEWHAT IMPORTANT 02

NEITHER IMPORTANT NOR
UNIMPORTANT. 03

NOT VERY IMPORTANT 04

NOT IMPORTANT AT ALL 05

A third thing you might think about in deciding how much clean water is worth to you is the satisfaction of knowina that a clean water river is there. POINT TO PART III OF VALUE CARD AND GIVE RESPONDENT TIME TO READ THAT PART. For example, you might be willing to pay something to maintain a public park even though you know you won't use it. The same thing could be true for clean water in the Monongahela; that is, you might pay something just for the satisfaction of knowing that it is clean and that others can use it.

In deciding how much clean water is worth to you, how important is knowing that a clean water river is being maintained? CIRCLE NUMBER.

VERY IMPORTANT.	01
SOMEWHAT IMPORTANT	02
NEITHER IMPORTANT NOR UNIMPORTANT.	03
NOT VERY IMPORTANT	04
NOT IMPORTANT AT ALL	05

The first paragraph of Question B-3, which introduces the payment vehicle to the respondent, is presented below:

Now, we would like you to think about the relationship between improving the quality of water in the Monongahela River and what we all have to pay each year as taxpayers and as consumers. We all pay <u>directly</u> through our tax dollars each year for cleaning up all rivers. We also pay <u>indirectly</u> each year through higher prices for the products we buy because it costs companies money to clean up water they use in making their products. Thus, each year, we are paying directly and indirectly for improvements in the water quality of the Monongahela River.

I want to ask you a few questions about what amount of money you would be willing to pay each year for different levels of water quality in the Monongahela River. Please keep in mind that the amounts you would pay each year would be paid in the form of taxes or in the form of higher prices for the products that companies sell.

This payment vehicle was selected because it corresponds with how people actually pay for water quality, connotes. no implicit starting point, and provides a vehicle that will bias the responses downward, if in any direction, because of public attitudes toward increased taxes and higher prices.

The introduction continues with a reference to the value card (see Figure 4-6) and requests that initial amounts be based on actual use and potential future use--user and option values but not existence values. The present overall level of water quality is described as Level D, where it is clean enough for boating.

Question B-3 embodies the comparison of the alternative contingent valuation methodologies. Specifically, by dividing the sample of 397 households into fourths and using a different color survey instrument for each quarter, Question B-3 compares the direct question method of eliciting willingness-to-pay amounts, both with and without a payment card (illustrated in Figure 4-7), to the iterative bidding games with $25 and $125 starting points. Thus, the questionnaire design provides an explicit test for starting point bias within the iterative bidding game, as well as a test for differences between direct questions and bidding games.

0	100	200	300	400	500	600	700
25	125	225	325	425	525	625	725
50	150	250	350	450	550	650	750
75	175	275	375	475	575	675	775

Figure 4-7. Payment card.

The payment card used in the direct question method was simply an array of numbers representing annual amounts from $0 to $775 per year. This is in contrast with the Mitchell and Carson [1981] payment card, which showed amounts individuals paid for various public goods adjusted to correspond with the respondent's income level. Mitchell and Carson split their sample to test for the effect of the different types of public goods provided, but the sample size in the Monongahela study was much smaller and already partitioned into four groups, so no anchoring amounts were listed on the payment card. Mitchell and Carson found no effect from the anchoring amounts, but this result may have been hampered by their adjustment of the amounts to correspond to the respondent's income level.

The hypothetical market queried the respondent for willingness-to-pay amounts for three water quality levels:

- Avoiding a decrease in water quality in the Monongahela River from D, boatable, to E, not suitable even for boating.
- Raising the water quality from D, beatable, to C, where gamefish could survive
- Raising the water quality from C, fishable, to B, where people could swim in the water.

Table 4-2 summarizes the formats for eliciting the option prices in the contingent valuation questionnaire. (For details on question procedures, see Appendix D, which contains a complete copy of the survey questionnaire.)

Table 4-2. Summary of Option Price Question Formats by Interview Type

Interview type	Question format
Iterative bidding, $25	To you (and your family), would it be worth $25 each year in higher taxes and prices for products that companies sell to keep the water quality in the Monongahela River from slipping back from Level D to Level E?
Iterative bidding, $125	To you (and your family), would it be worth $125 each year in higher taxes and prices for products that companies sell to keep the water quality in the Monongahela River from slipping back from Level D to Level E?
Direct question	What is the most it is worth to you (and your family) on a yearly basis to keep the water quality' in the Monongahela River from slipping back from Level D to Level E, where it is not even clean enough for boating?
Payment card	What is the most it is worth to you (and your family) on a yearly basis to keep the water quality in the Monongahela River from slipping back from Level D to Level E, where it is not even clean enough for boating?

The process for the direct question is very simple, with the interviewer asking the respondent for an amount for each level and stressing that additional amounts are being requested. The water quality ladder and the value card are in front of the respondent while the market process is initiated. The same procedure was used in the payment card format, with the only difference being that the payment card was given to the respondent.

Table 4-2 also summarizes the procedure for the bidding games with starting points. A similar procedure was used for both bidding games, the only difference being the starting points used. In the bidding game, the interviewer initiated the market process at the starting point and increased or decreased the requested amount until the respondent's maximum value was obtained. This was repeated for each of the water quality levels, with emphasis given to the additional nature of the amounts for the higher levels of water quality.

To conclude this part of the hypothetical market, the interviewer asked any respondent who gave a zero amount why that amount was given, as shown in the question below. The purpose of this question was to distinguish between a true zero amount and a zero that essentially represented a protest against either the experiment or some part of it, such as the payment vehicle.

we have found in studies of this type that people have a lot of different reasons for answering as they do. Some people felt they did not have enough information to give a dollar amount, some did not want to put dollar values on environmental quality, and some objected to the way the question was presented. Others gave a zero dollar amount because that was what it was worth to them.

which of these reasons best describes why you answered the way you did? REPEAT REASONS IF NECESSARY AND CIRCLE NUMBER.

NOT ENOUGH INFORMATION 01

DID NOT WANT TO PLACE DOLLAR VALUE 02

OBJECTED TO WAY QUESTION WAS PRESENTED . . 03

THAT IS WHAT IT IS WORTH 04

OTHER (SPECIFY) 05

The next section of the questionnaire attempted to break down the option price into its individual components of user and option values. The questions and results for option value are described in detail in the following chapter, so no additional discussion is provided in this chapter.

Part B contained two additional plausibility/consistency check questions that asked what effect improved water quality in the Monongahela River would have on visits to substitute sites and the Monongahela River sites. The answers to these questions were structured by choices ranging from a change (either increase or decrease) of more than five visits to no change or "don't know."*

The last question in Part B asked the respondent to perform a contingent ranking as specified by the text from the questionnaire. Figure 4-8 depicts one of the four combinations that the respondent was asked to rank. This particular card shows the combination of the lowest level of water quality and the lowest payment. Payment amounts of $50, $100, and $175 were paired with boatable, fishable, and swimmable levels of water quality, respectively. The survey design asked all respondents to rank the cards after participating in one of the other valuation exercises. This design is a compromise resulting from the limited resources available for sampling respondents and the objective to compare as many methods as possible. A complete comparison would have required an additional segmentation of the limited sample. Chapter 6 discusses the theory and results from the contingent ranking experiment.

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*These questions were suggested by the Office of Management and Budget (OMB) in its review of the survey questionnaire.

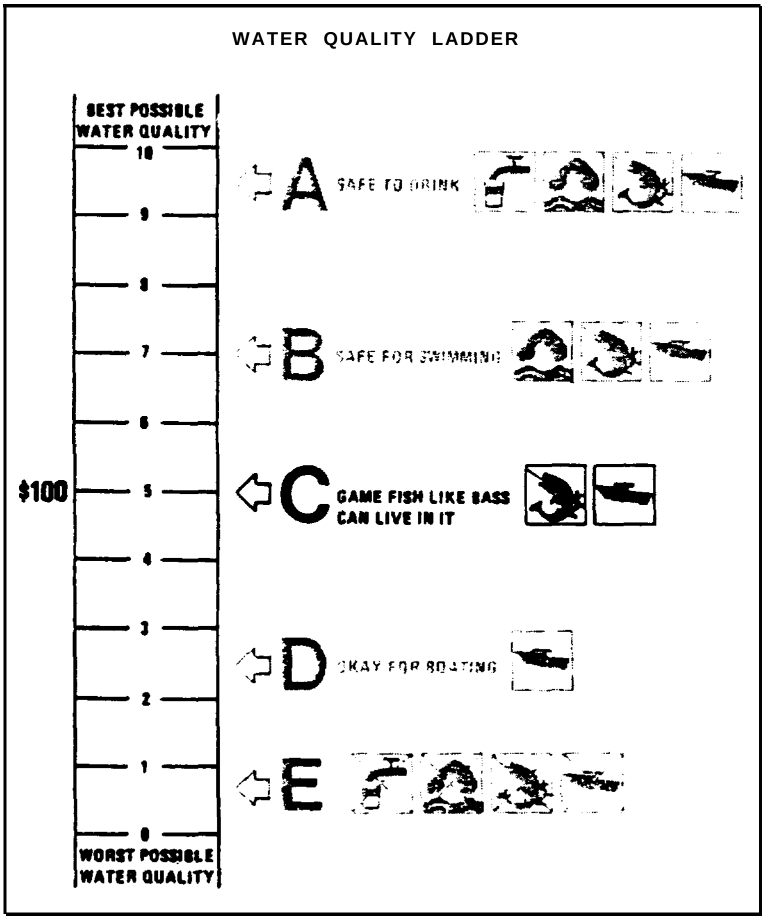

Figure 4-8. Rank order card.

4.4 PROFILES OF SURVEY RESPONDENTS

Respondents in a contingent valuatlon survey should represent the population of ‘interest to provide results. This section profiles the sample respondents from the Monongahela River basin area and compares these profiles with Census data for the area as a check for representativeness. Users, nonusers, zero bidders, and protest bidders are also profiled to assess the role of socioeconomic and attitudinal characteristics in influencing any of these groups.

Table 4-3 presents the characteristics of key groups of respondents in the Monongahela survey. These data are for the 301 completed questionnaires that provided valid responses. Two questionnaires were eliminated because the respondents were unable to complete the session. One person was 97 years oid and had difficulty seeing the cards; the other had troubie hearing the interviewer.